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NUTRITION *and* DIET
in
HEALTH *and* DISEASE

By

JAMES S. McLESTER, M.D.
Professor of Medicine at the University of Alabama
Birmingham, Alabama

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To

N. S. McL.

A. B. McL.

PREFACE

THIS book has been written from the point of view of the physician whose interests are general. It is hoped that it will be useful to both the student and the practitioner. It has been necessary for the sake of clearness to include much that belongs to the basic sciences, but the intimate relationship of this to the feeding of man is evident.

Two chief factors should govern all dietary regulation: first, the person's nutritive needs, whether in health or disease, and in disease, the nature of the physiologic disturbance; second, the combined experience of the past. The former is too often neglected, and the latter, as a rule, has been given undue weight. The endeavor here has been to balance these two—to base dietary rules on nutritional requirement, and to arrange the details according to the knowledge obtained from experience. Many oft quoted regimens which have the sanction of long tradition have been omitted, because on critical scrutiny it is apparent that they are without value. The space thus saved is given to a consideration of pathology. No apology is offered for the relatively large amount of space thus devoted to a discussion of disordered physiology, for without it intelligent dietary management is impossible.

I wish to express my thanks to Dr. McKim Marriott, Professor of Medicine in Washington University, St. Louis, for his kindness in contributing the chapter on The Feeding of Infants, and to Dr. Barney Brooks, Professor of Surgery in Vanderbilt University, Nashville, for his courtesy in supplying the chapter on Diets for Surgical Patients. These two contributions add greatly to the value of the book.

I wish also to acknowledge my appreciation of the help given by Miss Blanche Frazier in the assembling of material and the preparation of the manuscript, and by Mrs. H. W. Collins in the construction of the menus.

JAMES S. McLESTER.

930 SOUTH 20TH STREET
BIRMINGHAM, ALA.
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INTRODUCTION

Nutrition is the sum total of those processes by which the living organism receives and utilizes the materials necessary for the maintenance of life. This includes growth, the repair of worn-out structures, and the liberation of energy. The energy thus set free appears in the form of heat, mechanical work, electric currents, and perhaps also in ways yet unknown.

Food has been defined as a palatable mixture of foodstuffs. A foodstuff is a material capable of being added to the body substance, or which when absorbed into the blood stream will prevent or reduce the wasting of a necessary constituent of the organism.* For the animal organism, these nutritive substances are water, inorganic salts, the organic foodstuffs, and certain other substances of unknown chemical nature. The union of oxygen with the organic foodstuffs or their cleavage products maintains life and warmth in the cells.

Water and the mineral constituents of the food are too commonly ignored, and an adequate supply of the latter is often lacking in the diet. Both will be discussed in future chapters.

The well-known organic foodstuffs, carbohydrates, proteins and fats, in their highly organized structures contain stored energy which in large part is liberated in the body. Here, as elsewhere, the law of the conservation of energy is applied; and when these substances are broken down through oxidation to simpler chemical bodies, they give to the animal organism the same amount of energy as would be liberated by similar conversion in the test tube. The energy contained in any foodstuff may be determined accurately by measurement of the heat which it yields on combustion in a calorimeter. It is expressed in units of heat known as calories, a calorie being the amount of heat necessary to raise one kilogram of pure water from 15° to 16° C.

The utilizable portion of this stored energy varies somewhat according to its source; for the average mixed diet, Rubner† adopted the following "standard values:" 1 Gm. of carbohydrate yields 4.1 calories; 1 Gm. of protein, 4.1 calories; 1 Gm. of fat, 9.3 calories. For ordinary clinical purposes, however, the following values are accepted:

---

* Definition by Graham Lusk.

† Rubner, quoted by Lusk: The Science of Nutrition, p. 43.

1 Gm. of carbohydrate yields 4 calories; 1 Gm. of protein, 4 calories; 1 Gm. of fat, 9 calories.

Each of these three foodstuffs plays its own part in the processes of nutrition. Carbohydrates form the most important source of energy, which they yield as heat and mechanical work; they are the chief, perhaps the sole, source of muscle energy. Fats on oxidation liberate heat, and thus contribute to the maintenance of body warmth. Proteins serve mainly to repair worn out structures and to provide new tissues for the growing organism, but they may by converting a certain portion of their structure into glucose, accomplish the same purposes as carbohydrates and fats. The three may be substituted for one another to a certain extent. In the case of proteins, however, the substitution limits are particularly well defined, and indicate a point beyond which safe reduction or substitution is impossible; the presence in the diet of a small amount of nitrogenous food, "the wear and tear quota," is essential.

There is another group of food factors which, although required only in minute amounts, are absolutely essential. They are called vitamins. Their influence on the animal organism, their sources in nature and the diseases to which they are related are fairly well understood, but their chemical structure is yet unknown.

In the following chapters the manner in which these several foodstuffs are utilized and the influences exerted by each will be discussed. Then will follow an analysis of man's nutritive needs in health and in sickness, with a final consideration of the practical arrangement of the diet in disease.

PART I

NUTRITION IN HEALTH

SECTION A

The Need for Food and Its Utilization

NUTRITION AND DIET IN HEALTH AND DISEASE

CHAPTER I

METABOLISM

BASAL METABOLISM

The animal needs food in order to promote growth, to replace the parts of his tissues lost by wear and tear, and to meet his requirements for energy. The most pressing of these needs is the requirement for energy. This energy, which appears chiefly as heat or as mechanical work, is derived from the food through those manifold chemical changes which are grouped under the term metabolism.

Metabolic activity is lowest when the body is completely at rest and without food, for at this time heat production, mechanical work, and activity of the various organs are at the irreducible minimum. At this time, too, metabolism is not under the immediate influence of that stimulus—the specific dynamic action—which foods are known to exert. This lowest rate of energy exchange is called basal metabolism.

Basal metabolism furnishes the starting point from which proceed all computations of man's nutritive needs. It is expressed in the number of units of heat (calories) liberated per hour or per day. Its rate is proportionate to the surface area of the body, or more accurately stated, proportionate perhaps to some other more fundamental factor, such as protoplasmic mass, which in turn is in itself proportionate to surface area. Age also is a determining factor, for except in infancy, the younger the animal the greater the proportionate metabolic rate.[1] The basal metabolism of men between the ages of 20 and 50, with a body of average shape, has been found by measurement to be approximately 39.7 calories per square meter of body surface per hour; the figure for women is somewhat lower—36.9 calories.[2] These rates are surprisingly constant.

For the estimation of surface area several methods have been devised. The formula which because of its superior accuracy has come into general use is the "height-weight" formula of Du Bois. Taking

"A" as the surface area, "W" as the weight in kilograms, "H" as the height in centimeters and "C" as a constant, 71.84, it may be expressed as follows:

$$A = W^{0.425} \times H^{0.725} \times C$$

or

$$\text{Log } A = \log W \times 0.425 + \log H \times 0.725 + 1.8564.$$

By means of this formula, Du Bois has constructed a chart from which the surface area of a person of known height and weight can be read at a glance. This chart is widely used because of its convenience and accuracy. It will be found in the section on fuel requirement, Chapter III. A nomographic chart, also based on Du Bois' figures, has been devised by Boothby and Sandiford. (See chapter on Diabetes.)

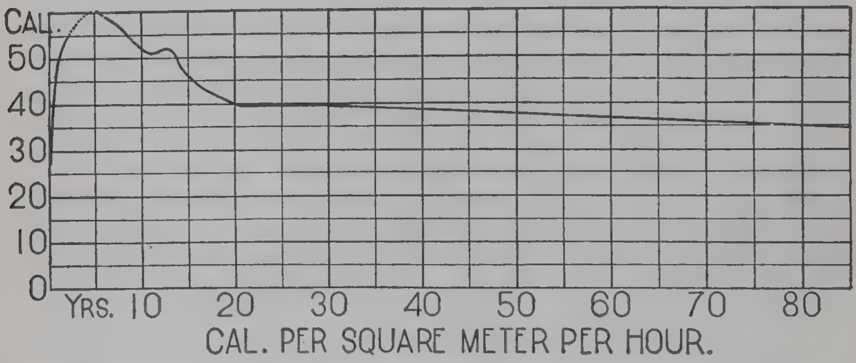

CHART 1.—Curve showing level of basal metabolism at different ages. The figures represent calories per square meter of body surface per hour. (Aub and Du Bois.)

Benedict[3] recently criticized the surface area law in its relation to basal metabolism; with Harris, by statistical means, he has devised a "prediction formula." Although the justice of this criticism is denied by Boothby and Sandiford,[4] and others, it is generally believed that Harris' formula will predict with accuracy the daily basal metabolism of a person of known height, weight and age, provided he is of average stature. The formula, together with a discussion of its merits, is given in Chapter III.

A rough estimate of the patient's basal metabolic rate, however, can be secured from his body weight. The basal metabolism for twenty-four hours of an adult of average size and shape is approximately 24 calories per kilogram, or 1 calorie per kilogram per hour; or more roughly still, 25 calories per kilogram per day. It should be reiterated, however, that while body weight can be made to serve as a convenient basis for rapid clinical estimation, for scientific study surface area gives the only accurate criterion.

The chemical changes called metabolism can be measured directly and to a high degree of accuracy by means of the calorimeter, an apparatus which measures the heat eliminated, the oxygen consumed, and the carbon dioxide and water given off. The urine and feces excreted during the period of observation also may be collected for analysis. This apparatus attains its highest degree of development in the modern Atwater-Rosa-Benedict respiratory calorimeter. The person to be observed is placed within the calorimeter, and all gaseous exchange and heat production are measured. The accuracy of the apparatus is such that even the slightest movement by the patient, with the resulting increased production of heat, is recorded. By means of the figures thus obtained, an accurate survey can be made of the sum total of the chemical changes which have taken place within the body.

For clinical purposes, other much simpler forms of apparatus have been devised. These measure the oxygen used and the carbon dioxide eliminated, or merely the oxygen, and thus through "indirect calorimetry" determine the rate of chemical change. The best known of these is the Tissot Spirometer, which permits an analysis of the expired air. This, in skilled hands, is extremely accurate. Benedict's Portable Apparatus, which measures merely the oxygen consumption, offers a convenient method for the clinical estimation of basal metabolism. There are several modifications of this apparatus on the market, as well as other types of simple construction based on the same principle. A good critical description of these is given by Du Bois.[5]

A warning should perhaps be given here. Faith should not be placed in the basal metabolic determinations made by unskilled persons with the various forms of simple apparatus on the market. At best, technical errors are frequent; normal variations in health reach at least ± 15 per cent, and interpretation is often difficult. It should be borne in mind also, that basal metabolic rate is only one link in the chain of diagnostic evidence, and that it should not be given disproportionate weight.

In a subsequent chapter which deals in a more specific manner with the fuel requirements of the body there will be found the charts and tables useful in reckoning basal metabolism.

Present knowledge of basal metabolism and standards for measurement are thoroughly discussed in recent monographs by Du Bois,[5] Boothby and Sandiford,[6] and McCann.[7]

RESPIRATORY QUOTIENT

In a given case, the gaseous exchange revealed by the calorimeter, together with the nitrogen elimination, as estimated in the urine, will show the exact amount of the several foodstuffs oxidized. For, while carbohydrates, proteids and fats when burned all consume oxygen and liberate carbon dioxide, the relative amounts of these two gases involved varies with the kind of material oxidized. The quantitative relation which these gases bear to one another, $\frac{\text{Volume } CO_2 \text{ produced}}{\text{Volume } O_2 \text{ consumed}}$ is known as the respiratory quotient.

To illustrate, take the combustion of carbohydrate. This foodstuff contains two atoms of hydrogen to every atom of oxygen; that is, these two elements are present in the exact proportion to form water, and when they are so united on combustion all the carbon atoms are left free to unite with the newly acquired oxygen. Therefore, the oxygen utilized in the combustion of carbohydrate can unite only with carbon and thus can lead only to the formation of carbon dioxide. In such a reaction one molecule of oxygen produces one molecule of carbon dioxide, and because of Avogadro's law that equal volumes of gases contain an equal number of molecules, the volume of O_2 consumed in the burning of carbohydrate exactly equals the volume of CO_2 given off. The respiratory quotient, then, is: $\frac{\text{Volume } CO_2}{\text{Volume } O_2} = 1.$

In the combustion of fat and protein, however, some of the oxygen consumed is used for purposes other than the production of carbon dioxide, and for this reason the volume of oxygen utilized is greater than that of the carbon dioxide liberated. Therefore, the respiratory quotient of each of these two foodstuffs is less than unity. It is found that when protein alone is metabolized the respiratory quotient is 0.80, for fat alone, it is 0.71. A respiratory quotient which is intermediate between these figures indicates the burning of a mixture of foodstuffs.

Under certain abnormal conditions, the respiratory quotient may exceed in either direction the figures given. Under normal conditions, the lowest obtainable quotient is that of fat, 0.71; at times, however still lower values are encountered, such as 0.613 reported in diabetes; this figure indicates that some of the absorbed oxygen was retained for purposes other than the production of carbon dioxide and water. This condition actually obtains when amino-acids are converted into glucose and as such are excreted in the urine, for the glucose molecule contains more oxygen than the amino-acid molecule. The reverse of this is true, and a respiratory quotient as high as 1.20 may be found

TABLE 1.—*Analysis of the Oxidation of Mixtures of Carbohydrate and Fat (Lusk)**

R. Q.	Percentage of Total Oxygen Consumed by:		Percentage of Total Heat Produced by:		Calories per Liter O_2	
	Carbohydrate (1)	Fat (2)	Carbohydrate (3)	Fat (4)	Number (5)	Logarithm (6)
0.707	0	100.0	0	100.0	4.686	0.67080
0.71	1.02	99.0	1.10	98.9	4.690	0.67114
0.72	4.44	95.6	4.76	95.2	4.702	0.67228
0.73	7.85	92.2	8.40	91.6	4.714	0.67342
0.74	11.3	88.7	12.0	88.0	4.727	0.67456
0.75	14.7	85.3	15.6	84.4	4.739	0.67569
0.76	18.1	81.9	19.2	80.8	4.751	0.67682
0.77	21.5	78.5	22.8	77.2	4.764	0.67794
0.78	24.9	75.1	26.3	73.7	4.776	0.67906
0.79	28.3	71.7	29.9	70.1	4.788	0.68018
0.80	31.7	68.3	33.4	66.6	4.801	0.68129
0.81	35.2	64.8	36.9	63.1	4.813	0.68241
0.82	38.6	61.4	40.3	59.7	4.825	0.68352
0.83	42.0	58.0	43.8	56.2	4.838	0.68463
0.84	45.4	54.6	47.2	52.8	4.850	0.68573
0.85	48.8	51.2	50.7	49.3	4.862	0.68683
0.86	52.2	47.8	54.1	45.9	4.875	0.68793
0.87	55.6	44.4	57.5	42.5	4.887	0.68903
0.88	59.0	41.0	60.8	39.2	4.899	0.69012
0.89	62.5	37.5	64.2	35.8	4.911	0.69121
0.90	65.9	34.1	67.5	32.5	4.924	0.69230
0.91	69.3	30.7	70.8	29.2	4.936	0.69339
0.92	72.7	27.3	74.1	25.9	4.948	0.69447
0.93	76.1	23.9	77.4	22.6	4.961	0.69555
0.94	79.5	20.5	80.7	19.3	4.973	0.69663
0.95	82.9	17.1	84.0	16.0	4.985	0.69770
0.96	86.3	13.7	87.2	12.8	4.998	0.69877
0.97	89.8	10.2	90.4	9.58	5.010	0.69984
0.98	93.2	6.83	93.6	6.37	5.022	0.70091
0.99	96.6	3.41	96.8	3.18	5.035	0.70197
1.00	100.0	0	100.0	0	5.047	0.70303

Formula for Column (R. Q. = R)

(1) $$\text{Per cent} = 100\,\frac{R - 0.707}{0.283}$$

(2) $$\text{Per cent} = 100\,\frac{1.00 - R}{0.293}$$

(3) $$\text{Per cent} = \frac{504.7(R - 0.707)}{5.047(R - 0.707) + 4.686(1.00 - R)}$$

(4) $$\text{Per cent} = \frac{468.6(1.00 - R)}{5.047(R - 0.707) + 4.686(1.00 - R)}$$

(5) $$\text{Calories} = 4.686 + \frac{R - 0707}{0.293} \times 0.361$$

(6) Logarithm = log of Column 5

* From Lusk, G.: Animal Calorimetry: Analysis of Oxidation Mixtures of Carbohydrate and Fat. Jour. Biol. Chem. **59,** 41–42, Feb. 1924.

when, as in the fattening process of the Strassburger goose, glucose is converted into fat and stored as such in the body.

A knowledge of the respiratory quotient obtained from the calorimeter can be utilized in the following manner for the determination of the several materials destroyed in metabolism. First, the protein which has been metabolized can be determined by multiplying the urinary nitrogen, expressed in grams, by the factor 6.25; for, 6.25 Gm. of protein contain 1 Gm. of nitrogen. Then, to estimate the amount of the other two foodstuffs utilized, the gases involved in protein destruction are first subtracted by adopting the figures of Loewy.[8] He has computed that in the metabolism of protein 8.45 liters of oxygen are required for the production of 1 Gm. of urinary nitrogen, and that in the same process 9.35 liters of carbon dioxide are liberated. With these figures are determined the volume of these two gases concerned in protein metabolism. When this is deducted from the total amount of oxygen absorbed and the amount of carbon dioxide eliminated, the respiratory quotient which remains, $\frac{(\text{Volume } CO_2)}{(\text{Volume } O_2)}$, will show the relative amounts of carbohydrates and fats metabolized (see Table 1.) Thus from a knowledge of the oxygen absorbed and the carbon dioxide and nitrogen eliminated during a certain period, it is possible to compute for that period the amounts of protein, carbohydrate and fat that were metabolized. The nitrogen figure, however, is not essential, because it is sufficiently accurate for clinical purposes to assume that 15 per cent of the calories of man's basal metabolism, estimated fourteen hours after a meal, are produced by protein and that the remaining calories are produced by oxidation of carbohydrates and fat. An excellent discussion of this subject, with useful diagrams, is given in Du Bois'[9] monograph.

THE METABOLISM OF STARVATION

The best understanding of an animal's nutritive needs can be had from a study of his metabolic processes during a period when he does not receive any food. To meet his requirements for energy during starvation, he oxidizes his own tissues. It is noteworthy that in order to protect these tissues at this time basal metabolism assumes a definitely lower level.

The starving animal first draws on his stores of carbohydrate (glycogen) and of "deposit protein;"* these are soon exhausted (or almost so); he then burns his body fat. If he is well supplied with fat, he subsists for a time almost exclusively on this, and destroys only the minimal quota of body protein. It should be borne in mind, however, that at no time, even in the presence of abundant stores of fat, does the protein destroyed fall below a certain minimum, the "wear and tear quota." As the animal exhausts his body fat, he draws more and more on his body protein, and at last, when all fat has been consumed, he lives solely at the expense of the protein. He draws on his several tissues to degrees varying in the inverse order of their physiologic importance, taking first those organs which are of least importance and conserving almost up to the last his most vital structures. When the latter are drawn on, death ensues.

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* The existence of deposit protein in the tissues is disputed.

It is interesting to note that even among organs of identical structure those which are of greatest importance are preserved intact longest. Thus, those bones which are of most importance from a structural standpoint, such as the long bones, maintain their integrity during starvation better than do the less important bones, such for instance as those of the skull. It has been shown that during starvation the animal at times breaks down certain less important organs for the upbuilding of those of greater importance.[10]

Table 2.—*Loss in Weight of Different Organs during Starvation**

	Fat-free Animal Contains in Percentage of Weight		Fresh Fat-free Organ Loses in Percentage Weight during a 24 Days' Fast
	Well Nourished	Starvation	
Skeleton	14.78	21.50	5
Skin	10.30	11.29	28
Muscles	53.77	48.39	42
Brain and cord	0.94	1.11	22
Eyes	0.11	0.16	3
Heart	0.54	0.69	16
Blood	7.14	5.69	48
Spleen	0.39	0.26	57
Liver	3.98	3.05	50
Pancreas	0.33	0.19	62
Kidney	0.66	0.45	55
Genitals	0.30	0.23	49
Stomach and intestine	5.81	6.02	32
Lungs	0.89	0.97	29

* This table is taken from Lusk, G.: The Science of Nutrition, ed. 3, 1921, p. 105.

It is evident, then, that man must have food for the preservation of life, and that if he does not get this food from normal sources, he will utilize his own tissues. In all questions of diet, both in health and in disease, this fact is of paramount importance.

The length of time which an animal can live without food varies greatly. The instance is recorded of a dog which fasted 117 days, during which time his weight fell from 26.3 to 9.76 kilograms. He was then permitted to regain his full strength. Later, he experienced a second fast of 104 days without disaster.[11] The professional faster, Succi, fasted thirty days on several occasions. Still longer fasts have been reported by others.[12] As a therapeutic measure, prolonged fasting has recently been tried in epilepsy; in some cases, the fast was continued for twenty-one days without harmful effect.

Concerning the body protein which is destroyed during starvation, Voit attempted to differentiate between circulating protein, which can be carried to the tissues and burned, and organized protein, which remains as an integral part of the body. It is clear today, however, that no such distinction is possible, and that this so-called circulating protein can be transported only in the form of amino-acids. Even the protein which is transferred from one organ to another, must first be broken down into amino-acids and later synthesized elsewhere into new protein.

The metabolism of starvation is remarkably constant; this is true even of the relative amounts of fat and protein which are destroyed at this time. This constancy is well illustrated by one of Benedict's experiments, in which a man throughout a seven days' fast each day metabolized practically the same amounts of protein and fat, and produced a surprisingly unvarying amount of heat.[13] Even different persons show approximately the same figures. Lusk concludes that a previously well-nourished person while fasting will obtain with a surprising degree of constancy 13 per cent of his energy from protein and 87 per cent from fat. The lowered output of urinary nitrogen which accompanies a prolonged fast finally gives place to a "premortal" rise which occurs just before death.

In starvation, especially, it is evident that fat is a much more economical source of energy than protein. While 900 calories may be obtained from 100 Gm. of fat, only about 90 calories are obtained from the oxidation of 100 Gm. of muscle. This explains why the starving animal loses weight much more rapidly after he has exhausted his fat, and is finally forced to live on his tissue proteins.

This loss of protein can largely be prevented if the patient will break his fast and take an abundance of fat or carbohydrate; but these last named foodstuffs alone can never cover protein loss in its entirety.

There is always a certain minimal destruction of protein which is an expression of the essential life processes. This "wear and tear quota" of the protein metabolism of man, under ideal conditions and by means of an appropriate diet containing sufficient carbohydrates, may be reduced to the point where there is a daily output of only 4 Gm. of urinary nitrogen, but it can be reduced no lower.

Prolonged fasting with its resulting abnormal fat metabolism leads to the production of large quantities of betaoxybutyric acid, aceto-acetic acid and acetone, with symptoms of acidosis. Through repeated fasts the organism seems to learn to utilize fats better, and as a result smaller amounts of these bodies are produced. Lusk quotes Abderhalden and Lampé's observations on a dog which through repeated fasts was able to utilize his fat better; he also refers to the experiments of Folin and Dennis, who concluded that "Repeated fasting applied to the obese is safe, harmless and effective, provided the intensity of the acidosis be carefully followed."

The blood during starvation shows surprisingly little change. The hemoglobin and cells remain practically the same, and the amino-acid content is undisturbed. The only constant change noted is a slight increase in the globulin and fat content of the plasma.

Death from starvation cannot be attributed directly to a failure of the cells to receive sufficient nourishment, for animals often die of starvation when they still possess an ample amount of body fat to nourish the cells; also, it is said that the cells after death from starvation show no gross changes. The most satisfactory explanation is that a loss of substance in the most important organs leads to a final breakdown of the machinery.

"The Physiological Effect of Under Nutrition" is the subject of a recent comprehensive review by Lusk.[14]

PROTEIN METABOLISM

The Amino-acids.—The protein of the food reaches the blood in the form of amino-acids and, circulating as such, it is taken up by the cells. These building stones, as they are called, are then resynthesized to be retained by the cell or they are broken up to furnish energy. In this destruction of the amino-acid a part is converted into glucose and another part, that which carries the nitrogen, undergoes changes which finally result in urea.[15]

The amount of glucose which an amino-acid is capable of yielding depends on its structure. Some amino-acids, such for instance as alanin, permit all of their carbon atoms to enter into the formation of glucose, while in others only a few of these atoms are given this power. In this connection the following fact is useful in metabolic reckonings: One gram of urinary nitrogen, which results from the metabolism of 6.25 Gm. of meat protein, is accompanied in the urine of a completely diabetic or a phlorhizinized animal by 3.65 Gm. of glucose, which warrants the conclusion that 6.25 Gm. of meat protein on metabolism is capable of yielding 3.65 Gm., or 58 per cent of glucose.

The glucose thus formed in intermediary protein metabolism behaves exactly as that obtained from other sources. It is oxidized for the production of energy and is otherwise subject to the same metabolic processes.

The amino-acid loses its nitrogen-carrying fraction by the process known as deamination. The amino radicle, as it is called, is converted first into ammonia, then into ammonium carbonate and finally into urea. Since this process cannot be imitated in the test tube, Lusk concludes that the "characteristic biologic reaction of deamination is effected through the activity of living tissue cells."

Specific Dynamic Action.—In addition to its other functions, protein exerts a peculiar, stimulating influence on metabolism, called its "specific dynamic action." This is seen when, following an increase of the protein in the food, even in the presence of an abundance of carbohydrate, metabolism assumes a definitely higher level. This effect is not experienced when the protein is retained for structural purposes or as deposit protein. The mechanism by which protein exerts this specific dynamic action is not entirely clear. It is not through any direct action of the amino-acids themselves, but is probably due to certain other intermediary products of protein metabolism which act directly on the protoplasm of the cell.

A point of practical dietetic importance is the fact that this specific dynamic action of protein is not in evidence when the body is exposed to very low temperatures, and that its effect of increasing heat production is most pronounced at high temperatures—an excellent reason why excessive quantities of meat should not be eaten in summer.

It should be added that carbohydrates and fats also have a specific dynamic action, though it is less pronounced than that of protein. The relative influence of each in increasing the metabolic rate is approximately: protein, 36.7 per cent; fat, 12.7 per cent, and sugar, 5.8 per cent.

Even water may have some such dynamic action. The increased excretion of urea which follows the copious drinking of water is thought by some physiologists to represent merely a better "washing out" of waste products which have accumulated in the tissues or the bringing into use of "deposit protein," but Hawk believes that water when taken in large quantities actually increases protein metabolism—perhaps a form of specific dynamic action.

The practical importance of the specific dynamic action of food lies in the fact that its influence must be considered in reckoning the diet. To the basal metabolism plus the metabolism of work there must still be added the "cost of digestion," as this action has been called. The specific dynamic action of various food factors has been discussed exhaustively by Lusk in a recent monograph.[16]

The Synthesis of Protein.—The value of a protein lies in its component amino-acids. A simple mixture of these in the pure state and in proper amounts will sustain life. In fact, dogs which have been fed solely on a carefully planned mixture of amino-acids not only have maintained nitrogen equilibrium, but also by adding new tissue to the body have exhibited a positive balance; thus it has been proved that the animal organism is capable of synthesizing protein. It is interesting that the protein thus formed partakes of the character of the body proteins rather than of the foodstuffs from which the amino-acids were derived.

If, however, any important amino-acid is missing from the protein or mixture of proteins, such food will not serve to maintain nitrogen equilibrium, and continued loss of body protein will occur. The best example of this is in the behavior of gelatin, which lacks three amino-acids—cystin, tyrosin and tryptophan. Feeding experiments have shown that while gelatin will spare a small amount of protein and during protein starvation will reduce the tissue loss to a certain extent (up to 38 per cent), it will never completely prevent this loss. If, however, the three missing amino-acids in suitable amounts are added to gelatin, the mixture is capable of preserving complete nitrogen balance. Evidently, then, in order to compensate for the wear and tear and to build new tissues, the body must receive from its protein food a complete supply of the proper building stones.

That the body in case of need can break down certain less important organs and use the building stones thus obtained to maintain the integrity or promote the growth of other organs, is proved by the oft quoted behavior of the salmon, which during a certain period of starvation and reproductive activity develops his reproductive organs at the expense of his muscle.

Nitrogen Balance.—Nitrogen balance must be considered in all problems of diet. When the nitrogen eliminated equals exactly that taken in the food, the animal is said to be in a state of nitrogen equilibrium. When the output exceeds the intake, he experiences a loss of protein, and the nitrogen balance is negative. When, on the other hand, the intake is the greater, the balance is positive. One requirement of the maintenance diet, so-called, is that it preserve nitrogen equilibrium.

Nitrogen equilibrium is not synonymous with minimal nitrogen metabolism, for equilibrium can be preserved at varying levels of protein metabolism, either high or low, according to the nature of the diet. With increased consumption of protein, the level at which nitrogen balance is obtained tends to become constantly higher. For instance, when a dog is given meat alone, there is required for nitrogen equilibrium an amount which is three and a half times that of the protein metabolized during starvation. If to this meat diet is added other foodstuffs, a much smaller amount of protein will suffice. The distinction between a relative minimum and an absolute minimum of protein intake must therefore be recognized.

By relative minimum is indicated the smallest amount of protein which, with a fixed quantity of other foodstuffs, will protect the body from loss of nitrogen. This varies according to the composition of the diet. By absolute nitrogen minimum is indicated the lowest level of protein intake at which equilibrium can be maintained under any circumstances. This can be reached only with a diet which contains an optimum mixture of foodstuffs. This optimum requirement is met by a diet which carries a sufficient amount of carbohydrates and fats, and in which the former supplies at least one half of the total energy. Such a mixture permits the reduction of protein to the absolute minimum while at the same time maintaining nitrogen equilibrium.

The figure which represents this absolute minimum of protein intake is not easily stated, for it depends also on factors other than the actual composition of the food, notably on the nutritive state of the individual. It is reported, for example, that in a suitably nourished person nitrogen equilibrium has been maintained on a diet of fat and potatoes which contained only 25 Gm. of protein. This, however, must be regarded as exceptional, for experience has shown that with an optimal mixture of carbohydrates and fats, a man weighing 70 kilograms requires about 40 Gm. of protein daily for the maintenance of nitrogen balance. However, this low quota of protein (40 Gm.) must not be accepted as a final standard for reckoning the ideal diet; for it should be emphasized that "minimal" and "optimal" as applied to protein intake are by no means synonymous. A more complete discussion of the optimal protein intake is reserved for a subsequent chapter.

Related to this question is the important observation quoted by Lusk that if the caloric value of the diet is low and nitrogen balance is preserved through the consumption of relatively large quantities of meat, the patient may nevertheless experience an appreciable loss of body fat. The lesson which this teaches in the treatment of obesity is obvious.

Creatinine.—In a discussion of intermediary protein metabolism something should be said of creatinine. It presents two paradoxes. It is a nitrogenous excretory product which results from protein metabolism, and yet the amount of this substance which is eliminated in the urine bears no relation to the amount of protein in the diet. Also, it is believed that creatinine is one of the end-products of muscle metabolism, and yet increased muscular activity does not lead to its increased production. It has been suggested that the amount of creatinine in the urine is a fair index of muscular development. Its greatest clinical interest, however, lies in the fact that its accumulation in the blood may be taken as an indication of greatly lowered kidney efficiency and of impending disaster.

The physiology of creatine and creatinine has been the subject of an article by Hunter,[17] to which the reader is referred.

CARBOHYDRATE METABOLISM

Starches and sugars are converted in the intestine into the hexoses, glucose, fructose and galactose, and are absorbed as such. Of these, glucose is by far the most important. Fructose apparently is converted into glucose, but galactose, especially in the adult, is less readily utilizable. On reaching the liver, glucose is converted into its anhydrid glycogen; it is stored as glycogen, and later, in order to meet the needs of the muscles for fuel, is again converted into glucose. Glycogen is found in practically all organs of the body, but the chief storehouses are the liver and the muscles; the former contains approximately half of the reserve glycogen. This store of glycogen is rapidly oxidized for the production of energy during continued or violent exercise. Comment has been made, however, on the tenacity with which the muscle, particularly the heart muscle, holds its diminishing reserve of glycogen, for it is impossible to remove from the body all traces of this important substance except by inducing tetanic convulsions.

When carbohydrate is not available in the food, the body, after drawing heavily on its stores of glycogen, breaks down its own tissue proteins, a part of which (58 per cent) is converted into glucose. This glucose is used primarily for the production of heat or muscle energy, but it may also be stored as glycogen.

When necessary, fat can take the place of glucose as a source of muscle energy; but there is a question as to whether fat can be utilized directly by the muscle cell or whether it must first be converted into glucose.[18] This brings up the much discussed point as to whether the organism is capable of converting fat into carbohydrate. Atwater,[19] in certain feeding experiments, found that carbohydrates had a higher energy value in the production of muscle work than was exhibited by an isodynamic quantity of fat, which would suggest that fat without conversion into something else is not directly utilizable by the muscles. Other experiments have been reported, however, which seem to indicate that the body is capable of utilizing the full energy value of fat for muscle work, and that this foodstuff therefore does not require preliminary conversion. Abderhalden has attempted to solve this problem by suggesting that even glucose itself is not utilized directly, but that it is presented to the muscle cell in some other form. He says that in an emergency both amino-acids and fatty acids, as well as glucose, are capable of conversion into this theoretical substance for subsequent use by the muscle. This is an attractive, though an unproved, conception of a complex problem.

In addition to its other functions, carbohydrate reduces protein metabolism. As has been said, an animal which lives on nitrogenous food alone, requires for nitrogen equilibrium three and a half times as much protein as would be metabolized during starvation. If carbohydrate is added to the animal's diet, the amount of meat necessary will be greatly reduced. Even the low protein metabolism seen in starvation can be brought to a still lower level by the ingestion of carbohydrate. In connection with this protein-sparing quality exhibited by carbohydrates, Lusk quotes the feeding experiments of Landergren, in which men were given diets consisting largely of carbohydrate and fat with an extremely small amount of protein, which causes a condition called "specific nitrogen hunger." The urinary nitrogen of these subjects which in starvation was about 10 Gm. a day, was thus reduced through the protecting influence of the carbohydrate and fat to about 4 Gm. a day. It has been found, however, that ingestion of fat alone has no such influence, for this foodstuff will not reduce the nitrogen output below that of starvation. Most effective in the sparing of protein is a mixture of carbohydrates and fats in which at least half the energy is supplied by the former. Thus it is seen that when the food consists largely of carbohydrates, a much lower level of protein metabolism can be obtained than is experienced when the diet is of protein or fat alone or of both. The Eskimo, because he eats little carbohydrate, must consume not only an abundance of fat, but large quantities of protein as well.

The fate of the glucose molecule in the body has been described by Shaffer[20] in his recent article on the Intermediary Metabolism of Carbohydrates.

FAT METABOLISM

Fat is important as a source of energy because of its relatively high caloric value. By contributing to the organism a large amount of energy, it relieves the intestinal tract of the necessity to deal with an excessive amount of carbohydrate food. To a certain extent, it spares protein, and thus permits the animal to maintain the nitrogen balance at a lower level. However, it should be reiterated that fat is not as effective in sparing protein as carbohydrate, and that life cannot be supported by fat alone.

During starvation fat is the chief source of energy, for, as is well known, the animal at this time lives largely on his own stores of fat. The blood of the starving animal contains a relatively large amount of this substance, and during this period of fat transport (as well as when he eats large quantities of fat) the animal stores a part of the fat in the liver. This storage is stopped, however, and the fat largely disappears if, as the result of carbohydrate feeding, glycogen storage begins. There seems to be an antagonism in the liver between the storage of fat and of glycogen.

Fat is split in the intestine to be absorbed in the form of fatty acids or soaps, and is immediately resynthesized in the intestinal wall. This new fat, which is transported to the blood stream largely by the thoracic duct, assumes the characteristics of the animals' own body fat, although when excessively large amounts are absorbed, it may retain the character of its origin. Minute droplets of fat, when present in excess, give to the blood plasma a slightly milky color; as a rule, however, the fat is taken up by the tissues as rapidly as it appears. It is stored as such or is oxidized by the cells for the production of heat.

Concerning the utilization of fat, the amount of this foodstuff which a man can safely metabolize is definitely limited by the amount of carbohydrate which he simultaneously oxidizes, for "the fats burn in the fire of carbohydrate." It has been estimated[21] that the oxidation of one glucose molecule will facilitate the oxidation of one fatty acid molecule, or taking their respective molecular weights into consideration, 1 Gm. of glucose will aid in the metabolism of 1.5 Gm. of fatty acid. Unless this amount of glucose is oxidized, the destruction of fat does not proceed beyond the beta-oxybuturic acid stage, and ketosis results—the fire smokes. The observance of this carbohydrate-fat ration of safety will be more fully discussed with the diet of diabetes mellitus.

A more complete discussion of the transport and utilization of fat, is given in articles by Bloor,[22] and further information regarding antiketogenesis may be found in articles by Woodyatt[21] and by Shaffer.[23]

THE MAINTENANCE OF BODY TEMPERATURE

The warm blooded animal maintains body temperature at its tropical level by balancing heat production with heat loss. This is accomplished in two ways: (1) by chemical regulation and (2) by physical regulation.

Chemical Regulation.—The oxidation processes of basal metabolism which occur within the cell are said to cause vibratory motions of the protoplasmic molecules, the energy of which is converted into heat sufficient in amount to maintain body warmth. When the temperature of the surrounding air approximates that of the body, this chemical regulation remains in abeyance. If, however, the temperature of the surrounding medium falls, reflex impulses arising in the skin lead to increased metabolic activity with resulting increased heat production. If the temperature goes still lower, this leads to involuntary movements of the muscles which are known as shivering; the increased metabolism of this involuntary muscular activity yields still more heat. Voluntary muscular activity accomplishes the same result.

In like manner greater heat production accompanies the increased metabolism caused by a cold bath; this heightened metabolic activity continues for some time after the bath. (Used in reduction cures.)

Heat production is influenced also by the kind and quantity of food which the animal eats. An increased intake of carbohydrate and fat through oxidation results in increased heat production. Not all of this food is thus utilized, however, since when eaten in excess a part is stored as fat. Increased protein intake leads directly to the increased output of heat through its stimulating dynamic action on metabolism; in addition that part of the protein molecule which is converted into glucose exhibits the usual heat giving properties of carbohydrate.

Physical Regulation.—Loss of heat occurs by means of (*a*) conduction and radiation from the skin, (*b*) the evaporation of water from the skin and lungs and (*c*) the warming of ingested food and inspired air. When it becomes necessary for the animal to lose heat, there is an increased flow of blood to the skin which through the dilated capillaries is exposed to the cooling effect of the surrounding medium. In addition, the sweat glands under such circumstances pour out more sweat, the evaporation of which is an important factor in the withdrawal of heat from the body. To this is added greater evaporation from the lungs and, by means of increased respiratory activity, the warming of a larger volume of inspired air.

The pathway of heat loss is determined largely by the humidity and the temperature of the surrounding medium. It has been estimated[24] that at room temperature and ordinary humidity, about 25 per cent of man's heat loss is through the evaporation of water, but on a hot day with an increased outpouring of sweat, this means of cooling is of still greater importance. On the other hand, if the air is humid, evaporation is a less potent regulator of temperature.

Body covering is another important factor. The great amount of stagnant air which is carried in the fur or hairy covering of animals conserves body heat by limiting conduction and radiation. The same applies to the clothing worn. In like manner, heat loss is limited by a generous layer of adipose tissue. All of these factors are important aids in the physical regulation of body temperature.

There is a full discussion of this subject in a recent monograph by Barbour.[25]

THE ACCOMPLISHMENT OF WORK

When the body is at rest the metabolic processes maintain a constant basic level (basal metabolism), but during and immediately after exercise these processes become greatly increased. This increased metabolism, which is necessary for the production of work, represents energy exchange within the cell.

How efficient is this muscle energy apparatus? One can accurately determine in terms of calories the amount of energy necessary for the accomplishment by an appropriate machine of a given piece of work. For instance, in a machine of this character, 1 calorie will furnish sufficient energy to raise 425 Kg. 1 meter, or, as it is expressed, 1 calorie equals 425 kilogrammeters. Likewise, the work done by a man with an ergostat can also be expressed in kilogrammeters. If the work done by man with such a machine is performed in a calorimeter, a comparison can be made of the number of calories theoretically necessary for the work and the number actually liberated in its accomplishment. This will show the mechanical efficiency of the human machine. As the result of such observations, it has been found that the human machine, while it may vary greatly, is approximately 20 per cent efficient; that is, in the accomplishment of a given piece of muscle work an amount of energy is liberated which is five times that theoretically necessary. This waste of energy is in the form of unnecessary muscle movements, increased heart action, increased respiratory activity and increased loss of heat through evaporation.

This is illustrated in Table 3.[26]

TABLE 3.—*Energy Required by Various Animals and Man to Carry Certain Weights**

Animal	Remarks	Body Weight Kg.	Energy Requirements in Kilogrammeters		Velocity in Meters per Minute of Horizontal Movement	Percentage of Incline of Road Ascended
			For Moving Horizontally 1 Kg. 1 Meter	For Raising 1 Kg. 1 Meter High		
Dog		26.9	0.495	2.954	78.57	17.2
Dog		26.9	0.501	3.259		
Horse		456.8	0.137	2.912	78.57	10.3
Man		72.9	0.217	3.190	71.32	6.5
Man		80.0	0.288	3.563	51.23	30.7–62.0
Man		88.2	0.263	3.555	42.34	
Man		80.0	0.244	2.729	56.54	23.0–30.5
Man		81.1	0.231	2.921	60.90	
Man	Normal gait	86.5	0.219	2.746	66.94	22.3
Man	Slow gait	86.5	0.233		35.92	
Man	Normal gait	65.8	0.230	2.846	63.95	
Man	Slow gait	65.8	0.151		34.58	

* This table is quoted from Abderhalden.

It is interesting to note that to carry forward 1 Kg. of body weight, a horse requires less energy than does a dog, and a large man less energy than one of smaller size. This difference in the influence of body mass, however, does not seem to hold good when it is a question of lifting the body as in climbing.

The author of Table 3 shows from the figures given how it is possible to estimate the amount of food required by a soldier on march. Assume that he weighs 70 Kg. and that he marches 74.4 meters per minute or 4.46 kilometers per hour. To carry on the level 1 Kg. of his body the distance of 1 meter requires 0.217 kilogrammeters. For the hour's march there would be required 0.217 by 4,460 by 70, or 67,747 kilogrammeters, which represents 159.4 calories and which in turn is the energy equivalent of 17.1 Gm. of fat. If in addition he must climb 500 meters, this increases the work done by 35,000 kilogrammeters (70 by 500). Since the soldier in this instance required three times the theoretic energy for 1 kilogrammeter, for this lifting he would require 105,000 kilogrammeters (3 by 3,500), which is equivalent to 246.75 calories or 26.5 Gm. of fat. Thus, this soldier, weighing 70 Kg. in order to march 4.46 kilometers in one hour and to surmount an elevation of 500 meters would require an amount of food equivalent in caloric value to 43.6 Gm. of fat in addition to the amount necessary for basal metabolism.

Literature on the Subject.—In his textbook, Abderhalden[27] discusses the physiology of work in an interesting manner, and in a recent article, Hill[28] gives a complete description of the mechanism and physiology of the contracting muscle.

NEUTRALITY REGULATION AND MOLECULAR CONCENTRATION

For the maintenance of life and the proper performance of function, the cells must be surrounded by a medium which at all times maintains an unchanging reaction and fixed molecular concentration.

Neutrality Regulation.—Distilled water, which is neutral in reaction, contains a certain number of dissociated hydrogen (H) and hydroxyl (OH) ions. One liter of distilled water contains one ten-millionth of a gram $\left(\frac{1}{10,000,000}\right)$ of free hydrogen ions, which may be written, 10^{-7}; or, taking the symbol commonly used $p_{\mathrm{H}} = 7$. This represents exact neutrality. Hydrogen ion concentrations less than this indicate alkalinity, and a greater concentration acidity. It must be borne in mind, however, that fractions are used, and that the larger the figure attached to the symbol p_{H}, the smaller the actual amount of hydrogen ions, and the smaller the figure the larger the number of dissociated hydrogen ions. Thus, while $p_{\mathrm{H}} = 7$ indicates neutrality, $p_{\mathrm{H}} = 6$ means acidity and $p_{\mathrm{H}} = 8$ means alkalinity. The reaction of the blood, which is just on the alkaline side of neutrality, is best expressed by the figure $p_{\mathrm{H}} = 7.45$.

The mildly alkaline reaction of the blood indicated by the foregoing figure must be maintained at all costs. Yet many products of metabolism are acid in reaction and tend to operate in the opposite direction, while certain abnormal metabolic processes make matters still worse by producing acids in large amounts, such for instance as the formation in diabetes of beta-oxybuturic and other acids. The body is able to protect itself against this, partly by an interplay of several mineral salts, called a "buffer" mixture. The basic elements of this mixture come from the food.

The processes by which the body in health preserves in the plasma this unchanging reaction, and in disease combats most effectively a tendency toward acidosis, are most complex and can be sketched here only in briefest outline. The mechanism includes three factors: (*a*) the lungs, (*b*) the kidneys and (*c*) the "buffer" mixture. In the blood, according to Austin and Cullen,[36] the systems of buffers in order of importance are: hemoglobin acid and its salt, carbonic acid and alkali carbonate, serum proteins and their salts, and monobasic and dibasic phosphate.

Carbonic acid, and the acids of sulphur and phosphorus which result from protein metabolism, as well as other acids, must be neutralized. This is done chiefly by sodium and potassium and to a less extent by the other basic elements. Ammonia under certain pathologic conditions is produced in increased amounts and plays a small part in the neutralization of acids, as do also the serum proteins to a slight extent. These last two factors, however, can never bulk large in neutrality regulation, for ammonia is probably toxic and cannot be retained in large amounts, and protein when broken down loses its acid fixing properties. For this purpose the basic elements received from the food are of overwhelming importance.

The acids of metabolism leave the body through the lungs and the kidneys; the carbon dioxide which comes from tissue combustion as well as the oxidation of organic acids goes by the former route and the other acids by the latter.

The respiratory mechanism is acutely sensitive to an excess of carbonic acid in the blood, and because of this it is able to preserve the normal relationship of carbonic acid to carbonate, as represented by the fraction $\frac{H_2CO_3}{NaHCO_3}$. If a large quantity of carbon dioxide is thrown into the circulation, the numerator of this fraction becomes greater and the value of the fraction increases; immediately, however, the lungs get rid of this excess of carbon dioxide and restore the relationship between the two chemical bodies, thus bringing the fraction again to its original value. Likewise, when any other acid enters the circulation and fastens on the alkali of this denominator, thus splitting the carbonate and setting free additional carbon dioxide, the value of the fraction is increased; again, the lungs eliminate an increased amount of carbon dioxide and thus reduce the numerator, while the kidneys conserve alkali, renewing the carbonate of the denominator, so that the fraction is again reduced automatically to its normal value.[30] Thus, by an efficient and highly sensitive regulatory mechanism, under ordinary conditions the lungs are able to preserve a constant ratio between carbon dioxide and bicarbonate, even though the former undergoes continuous increase and the latter through freshly introduced acids experiences constant destruction.

The kidney, through its ability to secrete an acid urine from a faintly alkaline blood, carries off phosphoric acid in the form of the monobasic acid salt (NaH_2PO_4) and leaves behind, to predominate in the blood, the diabasic alkaline phosphate Na_2HPO_4. Thus the kidney is able to rid the body of acids while it conserves the supply of alkalis.

Sulphuric acid, which results from protein metabolism, is not so easily disposed of; it is excreted as the neutral salt. It deprives the weaker carbonates and phosphates of a part of their bases, and as the sulphate of these it is excreted by the kidney. The carbon dioxide thus set free passes off through the lungs, as was seen above, without altering the reaction of the blood.

Phosphates are changed in this process from the dibasic (Na_2HPO_4) to the monobasic (NaH_2PO_4) salt, but since the relatively mild acid reaction of the latter, and the equally mild basic reaction of the former differs only in small degree, the resulting change in the reaction of the blood is slight. An extensive readjustment of these salts can occur without appreciable change in the reaction of the medium. The "buffer effect" of these salts, as it is called, enables the blood to take up a relatively large amount of acid while at the same time it preserves its neutrality.

The processes above outlined are accompanied by a small but constant loss of basic elements to the body; to meet this drain the blood draws on the alkali reserve of the tissues. This store of basic elements is not unlimited, and in last analysis the loss must be made good by the food. Sherman and Gettler[31] first called attention through their ash analyses to the respective base or acid-forming qualities of the different foods, and they pointed out the importance of these qualities in the animal economy. In general it can be said that vegetables and fruits yield basic elements, while the cereals, meats and fish are acidic in their tendency. This quality of foods has been studied further by Blatherwick,[32] who discusses the influence of base and of acid-forming diets on the urine. He states that potatoes, oranges, raisins, apples, bananas and canteloupe are excellent base-supplying foods; while plums, prunes and cranberries, because of the benzoic acid which they contain, are acidic in their influence in spite of their basic ash.

The beneficial effects of foods which are predominatingly basic, especially in nephritis, has been discussed in a practical way by Sansum, Blatherwick and Smith.[33] This will be reviewed more fully in the chapter on nephritis in which tables of acid and base-forming foods will be given.

Molecular Concentration.—The animal cell requires a surrounding medium which contains salts of sufficient molecular concentration to maintain in this fluid a certain unchanging osmotic pressure. It will be recalled that the osmotic pressure of a fluid depends on the actual number of dissolved molecules, not on their volume, and since molecules of albumen and globulin are of such enormous size that they are present in the body fluids in relatively small numbers, any possible effect which these may have on the osmotic pressure of the blood may be disregarded. Therefore dissolved salts only, with their infinitely smaller molecules, can be reckoned as of appreciable value in the maintenance of osmotic pressure. These salts are always present in the plasma in the same amounts, and they maintain an unchanging osmotic pressure. The maintenance of this unvarying saline concentration in the plasma presupposes an adequate supply of inorganic salts in the food. If this supply falls below the requisite amount, the plasma draws on all possible stores of inorganic material, while at the same time the kidney as the regulator of salt exchange curtails the output. By such means does the body maintain in its fluids the osmotic pressure essential to life. If this mechanism is to operate long without disastrous results, it must be with the aid of a dietary which contains an adequate supply of inorganic salts.

Literature on These Subjects.—The chemistry and physics of neutrality regulation are described fully in the writings of Henderson.[34] The subject is also well covered in recent monographs by Wilson,[35] and by Austin and Cullen,[36] and the relation particularly to mineral metabolism is discussed by Shohl.[37] Statements concerning the reactions involved are also given with clearness and brevity by Lusk[38] and by Sherman.[39] For further information concerning the base and acid forming qualities of foods the reader is referred to the articles by Sherman and Gettler,[31] by Blatherwick[32] and by Sansum, et al.[33]

THE METABOLISM OF THE CELL

The form in which the several nutritive substances are presented to the cell, the manner in which they are taken up, the changes which they undergo and the influences which they exert on the different parts of the cell, are all questions of interest. Although the newer knowledge of the laws of physical chemistry has brought a clearer understanding of these processes, their solution is as yet far from complete.

Many of the changes which occur within the cell can be reproduced in the test tube. Since, however, such reactions in vitro often require intense heat or other conditions which do not hold within the tissues, it must be concluded that there exist within the cell certain favorable factors which do not operate in vitro. Also, it should not be forgotten that while a given reaction may produce the same end products in both cell and test tube, it has not been proved that the several intermediary steps are the same in both. To explain the mechanism of the changes which occur within the cell it is customary to assume the action of cell ferments (glycogenase); yet this does not finally solve the problem, for it does not explain how the ferment acts nor does it explain the successive steps involved.

It is evident that these intracellular reactions are extremely complex. Each change has its influence on the others, and each determines the conditions for subsequent reactions. Such cell processes involve chemical, physical and physicochemical reactions: osmosis, absorption, surface tension, electrical activity, all play a part. The physical state of the nutritive substance, whether crystalloid or colloid, whether in solution or suspension, the degree of its dissociation, etc., are likewise determining factors. A knowledge of the structure of the cell, of the stereochemical arrangement of its component molecules, and of the chemical and physical characteristics of the so-called membrane, is of help in clarifying our understanding of these metabolic processes. A complete explanation will not be found in any single field of scientific study. Only as knowledge of all such fields deepens will there be a clearer insight into these intimate metabolic processes. Today we are forced to develop our conceptions of intracellular metabolism largely from a knowledge of what enters and of what leaves the cell.

By what means does the cell take up nutritive material and cast off waste products? What factors, chemical or physical, are concerned in these processes? Diffusion and osmosis immediately suggest themselves, and unquestionably each plays a rôle. If a dissolved substance exists in the surrounding medium in greater concentration than within the cell, this substance, according to such physical laws, passes through the membrane into the cell and continues so to pass until the concentration on both sides is equal. If, however, this substance on entrance is immediately taken up and becomes united with some other cell component, the osmotic pressure exerted by it within the cell ceases, and because of this, its incoming movement can be continued even after apparent saturation. By such a process of "coupling" the cell becomes able to take up a much larger amount of a needed substance than at first glance appears possible. Conversely, the continued production by the cell of some waste material or secretory substance leads to a constantly positive osmotic pressure of this substance within the cell and therefore to its continual outward passage. Thus, by rearrangement of its colloid molecules as well as by absorption and other physical means, the cell can control to a certain extent the osmotic pressure of any given substance within itself. We can picture to ourselves a mechanism of this character by means of which the cell maintains complete control of its intake and output.

Unfortunately, the assumption that the cell works simply with a mechanism of selective osmosis will not suffice in every case. For instance, why is it that the red blood cells of the horse do not contain sodium although this element is abundant in the surrounding plasma? Why is it that the mammary glands of different species of animals, while drawing their building materials from a plasma which is practically identical in all, secrete milk of such widely varying composition? Questions such as these force the conclusion that the cell in carrying on its chemical interchange with the surrounding medium, whether nutritive, secretory or excretory, is influenced by forces other than simple osmosis.

Two views are held concerning the intimacy of the relationship between the cell and its nutritive substances. Do these nutritive substances on gaining entrance become an integral part of the cell? Or, does the cell consist of a permanent unchanging structure in the meshes of which such substances are dissolved or suspended, to exhibit in this state their physical and chemical activities? It would appear that the former view is correct; that everything which enters the cell becomes a part of its structure, and that every part is concerned in the energy exchange called metabolism.

It is customary to assume the existence of a surrounding membrane which controls the external relations of the cell and in large measure determines its activities. Unquestionably, the cell is surrounded by a layer of colloid substance, but it is doubtful whether the term "membrane" is applicable. This boundary layer has long been thought to consist of lecithin and other fatlike substances, and for this reason has been called the lipoid membrane. It was believed that only such substances as are soluble in lipoids could pass and that other substances must therefore undergo suitable change before absorption. There are reasons to-day however, for believing that this outer layer is not of exclusively lipoid nature.

It must be assumed, for the reasons above given, that this outer layer of the cell is of specific permeability—probably of a specificity which varies from time to time. When we recall that it is colloid in nature, and that colloids possess almost unlimited possibilities for chemical and physical combination and rearrangement, we get some conception of the great capabilities of the outer cell layer for selective activity.

Certain new and interesting facts concerning the manner in which the cell grows and nourishes itself is told by Carrel[40] in a recent article dealing with tissue culture.

FERMENT ACTION

Ferments play an all-important rôle in nutrition. Each living cell is provided with ferments—many in fact—and with the aid of these its various activities are unfolded. A reaction which we regard as a single intracellular process often represents several separate splittings or rearrangement of molecules, in each step of which a special ferment is the controlling factor; for instance, the removal of the amino group from an amino-acid (deamination) is accomplished by a certain ferment, while the conversion of the remaining group into glucose requires another. If this glucose is oxidized or is converted into glycogen or fat, still other ferments are concerned. Except in their specific affinities, these ferments apparently do not differ from those encountered in the gastro-intestinal tract.

Of the chemical nature of ferments, of their structure and of the manner in which they work, much has been written but little is actually known. It has been suggested that they are of varying chemical nature, the structure of each being akin to that of the substrate on which it works; that, for instance, invertin, which splits cane sugar, is itself a carbohydrate with radicles which fit into appropriate radicles of the cane sugar; or that the deaminizing ferment exhibits in itself the characteristic "amino" structure. Or perhaps, as has been suggested, ferments are merely simple well known chemical bodies, such for instance as amino-acids, whose characteristic activity is determined by the conditions which surround them.

Then, too, there is good support for the often expressed belief that ferments exist in a colloidal state. Opposed to this, however, is the hypothesis that the colloid body is merely the carrier of the ferment, and that on its extensive surface, ferment and substrate are brought into intimate contact. Another view is that all ferments are of identical nature and structure, and that their difference in action is due to some accompanying substance which attaches itself to the ferment and determines its behavior. These and many other theories have been offered.

Since no one has succeeded in isolating a ferment or in accurately determining its physical or chemical nature, it is necessary to characterize all such bodies according to the nature of their work and to the circumstances under which they unfold their activities. While their chief function is to carry on the activities of the cell, they are at the same time themselves the result of cell activity. In certain instances a ferment is the chief cell product (pepsin), while in other instances it is merely a by-product (such as the ferment within the muscle cell which breaks down the glycogen molecule for the production of mechanical work). Some ferments are poured out by the cell into a duct, and others are given off to the blood and in this medium find their way to various parts of the body, while still others as true intracellular ferments exert their influence only within the cell.

Many ferments appear first in an inactive form (or zymogen) to be converted later through the aid of some other substance into the active form. Witness the conversion of pepsinogen into pepsin by means of hydrochloric acid or the lipasezymogen into lipase through the action of bile acids.

The most interesting thing about a ferment is its manner of action. Its presence is necessary only in extremely minute amounts, and at the end of the reaction the ferment is unimpaired and ready for further work.* Physical conditions often determine ferment activity. Of great importance among these is the reaction of the surrounding medium. Certain ferments will act only in acid solutions, others only in alkaline. In many instances, the rapidity of the reaction is determined by the hydrogen ion concentration of the solution. Witness the influence of the acid gastric juice and the alkaline intestinal fluids, respectively, on pepsin and trypsin. Of equal importance is the temperature and the physical state of the substance to be acted on. All ferments have an optimum temperature as well as an optimum reaction of surrounding medium. Many other circumstances, some known and some unknown, influence ferment activity.

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* The destruction of the ferment in small quantities (pepsin) occurs as the reaction proceeds but this is due to the temperature at which the ferment works and not to the reaction itself.

Ferments are said to furnish the connecting link between the cells and the outer world. Without their aid the animal organism could not avail itself of the food which is at its disposal, and the cells would not be able to utilize the nutritive materials which reach them through the blood and lymph.

Are all metabolic activities to be credited to ferment action? Because a ferment cannot accurately be defined I am at a loss for an answer. Many reactions which are characteristic of ferment activity will actually proceed, though with extreme slowness, in the absence of any ferment. On the other hand, reactions do occur within the cell which it is impossible to duplicate elsewhere, and in such instances it is necessary to assume not only optimum physical conditions but in addition the presence of some other substance which we are forced to call a ferment. Without the aid of ferments, how can the many different cells of the body build from a common pabulum, each for itself, those structural substances which are peculiar to its own cell body? The liver cell and the muscle fiber builds its own structure from a common mass of building stones, each choosing such as it needs and casting the others aside. From such considerations, I am tempted to say that all metabolic activity is the result of ferment action, and to subscribe to the view that every cell is provided with many ferments and that these are specific in nature.

A THEORY OF METABOLISM

The following is an abbreviation of the theory of metabolism formulated by Lusk.[41]

In each mammal there is a basal metabolism which represents the minimal heat production, with the animal at rest, eighteen hours after he has taken a mixed diet. The cells at this time are nourished by fat and carbohydrate, the supply of the latter being under the control of the liver.

This basal metabolism may be increased by food in the following ways:

1. *Amino-acid Stimulation.*—The intermediary products of protein metabolism directly stimulate the cell to increased oxidative activity.

2. *Fat Plethora.*—The fat coming from the gut increases metabolism by its own oxidation. The increased heat production which comes from fatty acids may be represented as a series of successive ultra-micro-explosions occurring within the cell.

3. *Carbohydrate Plethora.*—The carbohydrate coming from the intestine increases heat production. The intermediary products of carbohydrate metabolism are more readily oxidized in the body than fat, and when these are present in sufficient amount to satisfy the energy requirements of the cell, they are oxidized to the exclusion of fat. It appears that basal metabolism is increased only in the presence of a plethora of dissociated fragments of sugar. Beyond a certain point these are no longer burned, but are converted into fat and stored as such.

4. *Carbohydrate and Fat Plethora.*—Here there is a summation of effect in that each seems to exert its own influence on the cell independently of the other.

5. *Amino-acid Stimulation and Carbohydrate and Fat Plethora.*—It would appear that all three act independently, and that food may act on the quiet resting cell through the following independent mechanisms:

(*a*) A mechanism which receives its stimulus from certain amino-acids.

(*b*) A mechanism of carbohydrate plethora which permits the metabolism of sugar up to the limits imposed by "self regulation."

(*c*) A mechanism capable of receiving power from the oxidation of fat.

Literature on the Subject.—For further study of the several phases of metabolism discussed in this chapter, the reader is referred to Lusk's[42] "Science of Nutrition," Du Bois'[5] "Basal Metabolism" and Abderhalden's[43] "Lehrbuch der Physiologische Chemie."

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CHAPTER II

DIGESTION AND ABSORPTION

The object of digestion is to render the food absorbable. This is accomplished by physical and chemical means. A few nutritive substances do not require digestion and are absorbed as such, but all other foodstuffs must undergo profound changes before they are utilizable.

The Mouth.—Digestion begins in the mouth where the food is subjected to a twofold process. First, while being constantly moistened and softened by the saliva, it undergoes maceration through the grinding action of the teeth. Then, after being rendered slightly alkaline and reduced to the proper physical state, it is subjected to the influence of the ferment ptyalin, with the result that starch is converted into maltose. Ptyalin will not dissolve the cellulose capsule, however, and therefore, to break open the capsule and permit the action of this ferment, it is essential that the food be thorougly cooked. Only a very small portion of the starch eaten is acted on in the mouth; later, it is subjected to further ptyalin action in the stomach, and then it is completely digested in the intestine. Of the processes to which the food is subjected in the mouth, maceration and moistening is more important than ferment action.

The saliva has another important function. It brings into solution certain substances agreeable to the taste; these in turn act on appropriate nerve endings and thus serve the important purpose of stimulating the appetite and of starting the flow of other digestive juices.

The Stomach.—The food reaches the stomach in a soft, semi-solid state, and for a time remains at the cardiac end just below the esophagus. As this accumulation grows larger, that which first reached the stomach is pushed toward the periphery, and that which was swallowed last remains in the center of the mass. The muscular movements at this end of the stomach are not rapid, and the acid juices are gradually and slowly worked into the food mass. Thus, for half an hour or more the center of this mass remains alkaline or neutral, during which period ptyalin digestion continues. Gradually, however, as the chyme becomes more thoroughly permeated by the gastric juices, it is thrown into the antrum of the stomach, where peristaltic action subjects it to a more active mechanical treatment.

The regularly recurring peristaltic waves, arising at the junction of the fundus and the antrum, force the food onward to the pylorus where it encounters obstruction, and until the time is ripe for its further passage it is intermittently thrown forward and forced backward. These rush waves, following in quick succession about once in twenty seconds, accomplish the chief object of stomach digestion, a thorough churning and mixing of food and gastric juices.

While this mixing process goes on, the gastric juice exerts its chemical effect. The action of the gastric juice is dependent on its several ferments and on its acid reaction.

This reaction is produced by the free hydrochloric acid secreted by the parietal cells of the glands situated in the fundus. It was at first thought that gastric juice contained only the amount of acid which is usually observed on clinical examination, about 0.2 per cent, but it has more recently been shown that it actually contains 0.4 or 0.5 per cent of hydrochloric acid, which is in part neutralized through regurgitation of alkaline fluid from the intestine.[1] The hydrochloric acid of the stomach has three functions: It has an antiseptic action which destroys swallowed bacteria; it splits cane sugar into glucose and fructose; and it unites with the proteins of the food to form a substrate which is suitable for the action of pepsin, the chief enzyme of the gastric juice.

Pepsin comes from the "chief cells" of the glands situated both in the fundus and at the pylorus; it does not at first appear as such but is secreted as the zymogen, or proferment pepsinogen, and becomes active under the influence of hydrochloric acid. With the aid of hydrochloric acid, it attacks the proteins of the food and splits them into simplier compounds. It was long thought that the protein-splitting process accomplished by pepsin went no further than the production of proteoses and peptones, bodies which retain some of the characteristics of albumen, but it is now evident that simpler compounds, polypeptids and even amino-acids, are also produced to a small extent during stomach digestion.[2] These proteoses, peptones and other split products thus formed in the stomach are poured as such into the intestine, and they there undergo further disintegration.

Another ferment secreted by the glands of the stomach is the milk-curdling enzyme, rennin, which, like pepsin, appears first as a proferment. Evidence has been offered to show that rennin is not a separate ferment, and that it represents merely one atom-group or side-chain of a large molecule, of which the chief atom-group is pepsin. It seems best as yet, however, to assume the existence of a separate milk-

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curdling ferment. With the aid of calcium, rennin converts the caseinogen of milk into insoluble casein, which is subjected to the proteolytic action of pepsin and hydrochloric acid.

A third ferment, lipase, which acts on fat, is also found in the stomach. Whether it originates here or finds its way into this organ with the regurgitated duodenal contents, is a matter of question. Gastric lipase splits fat into fatty acids and glycerol, but this action is not sufficiently extensive to aid digestion. Like rennin, this ferment is of more importance to the suckling than to the adult.

Stimulation of gastric juice proceeds in two ways, through psychic influences and by chemical means. The former, which is dependent on the presence of hunger or appetite and acts through the vagus nerves, gives an immediate response, producing the so-called "appetite secretion."[3] Examples of this could be multiplied. The powerful stimulation arising from the sight, taste or smell of food is well known: the "sham" feeding of a dog with an esophageal fistula, or even the exhibition of food to the hungry animal, with its accompanying outpouring of gastric juice, is striking. Conversely, the stoppage of gastric secretion, which accompanies anger or other disagreeable emotions, furnishes an illustration of the inhibitory action of psychic influences. I have never forgotten a dog with a gastric fistula from which large quantities of gastric juice could be secured provided he remained in a good humor, but whose secretory activity immediately stopped when a certain person whom he disliked entered the room. Experience with that dog has given me a much better appreciation of the digestive troubles of emotionally unstable patients. This appreciation of the influence of psychic factors on gastric secretion is a matter of importance for the physician.

Chemical stimuli to gastric secretion act more tardily, but they have the advantage of continuing over a longer period of time. Many of the products of digestion serve as a direct chemical stimulant to the gastric mucosa; others are first absorbed into the blood stream and there exert their influence; still others stimulate a certain portion of the mucosa near the pylorus and cause it to liberate the hormone, gastrin (or the gastrins), which in turn excites fundic glandular activity.[4] Related to the other chemical stimuli is that which comes from the drinking of fluids, for water, as was first shown in the classic experiment of Pawlow,[5] causes a prompt outpouring of gastric juice. In agreement with this convincing evidence, it has been asserted that the drinking of water with meals aids digestion and produces no undesirable effects.[6] Thus it is seen that while psychic stimuli act first and initiate the flow of the digestive juices, the more slowly acting chemical stimuli last longer and are of greater importance. Independently of these stimuli there is normally in the fasting stomach a small but continuous secretion of true gastric juice.[7]

The absorption of nutritive material from the stomach need not be considered. The foodstuffs in this organ do not ordinarily reach that advanced stage of digestion at which absorption is possible, and it is probable that only inconsiderable amounts of water, salts, peptones and certain sugars find passage through the stomach wall.

When the gastric contents are thoroughly acid and well chymified, the pylorus relaxes and the stomach begins to empty itself. During the short periods of relaxation of the pylorus the stomach ejects portions of its contents into the duodenum, whence in turn come inhibitory stimuli arising through the action of this acid chyme on the duodenal mucosa, causing the pylorus to close again. In addition to this chemical factor, it would appear that the pylorus in its opening and closing is under the influence also of antagonistic mechanical stimuli arising from the presence of the food mass in stomach or duodenum.[8] This intermittent opening and closing of the pylorus, which begins perhaps only a short while after the taking of food, continues until the stomach is empty. The time which it takes the stomach to empty itself varies with the kind of food. Carbohydrates leave the stomach first, and fats, when taken alone, remain longest. The usual mixture of foodstuffs require about five or six hours for complete emptying.

The Intestines.—The chyme on reaching the intestine is next brought into contact both with the pancreatic juices and with the secretions from the glands of Brunner. The latter secretions are alkaline in reaction and contain both a ferment and a kinase. This ferment, invertin, is not of great service, since it merely splits small amounts of cane sugar. The kinase, known as enterokinase, is, however, of great importance in that it converts the trypsinogen of the pancreatic juice into the actively proteolytic ferment trypsin.

The pancreatic secretions pour into the duodenum a short distance below the pylorus; they are strongly alkaline and contain ferments which act on all classes of foodstuffs. The most important of these ferments, trypsin, acts best in this alkaline medium, although its digestive powers are not entirely stopped by the frequent changes which occur in the reaction of the duodenal contents.

Trypsin is more rapid and more complete in its action than pepsin. It not only splits the petones and other intermediary products resulting from pepsin digestion, but it attacks as well those proteins of the food which chance to come intact through the stomach. It differs from pepsin chiefly in the rapidity of its action and in the completeness with which it digests protein down to the formation of the simplest split-products, the amino-acids. Trypsin digestion of proteids does not cease until this final amino-acid stage is reached.

Pancreatic juice possesses in addition other digestive ferments. It has an amylopsin which hydrolyzes starch to erythro dextrin and maltose. The latter, under the influence of a further ferment, maltase, is then converted into glucose. So powerful is this amylase that it is said to digest even unboiled starch. Lipase, as the fat-splitting ferment of this juice is called, splits the fats into glycerol and fatty acids. The latter then unite with the alkalis of this fluid to form soap.

The flow of pancreatic juice is believed to be regulated chiefly by a so-called hormone, secretin. This comes as prosecretin from the epithelial cells of the duodenum and upper jejunum and is first rendered active by the hydrochloric acid of the incoming gastric chyme. It then reaches the pancreas through the blood stream. Thus each new influx of gastric chyme leads to the production of a fresh supply of secretin, which on being absorbed is carried to the pancreas and stimulates that organ to fresh activity. When the duodenal contents finally become neutralized, this stimulus to the pancreas ceases. Pancreatic activity can also be aroused by influences coming through the vagus nerve. This dual character of these stimuli is reminiscent of the twofold method of stimulating gastric secretion.

The pancreatic juices are aided by the bile, which plays an important rôle in the intestine. Bile has many functions, chief among which is its solvent action on fatty acids and soaps. It facilitates the absorption of these substances and is also absorbed with them. In addition, by altering the surface tension of the fluid medium, it permits the lypolytic ferments to enter into closer relationship with the fat globules and to act on them. When the secretions of the liver fail to reach the intestine in sufficient quantity, the resulting large fat content of the feces is evidence of the paramount importance of bile to the proper utilization of fat. It has weakly amylolytic powers. Also, through its function of ridding the intestine of substances which are prone to undergo bacterial decomposition, it has a mildly antiseptic action.

The secretion of bile is influenced by several factors, particularly by the stimulating action on the duodenal mucosa of fats and protein digestion products, and also by a secretin-like hormone. Its output while variable in amount is probably continuous; the gallbladder serves as a temporary reservoir for a portion but probably not for all of the bile output.

The glands of Lieberkühn situated in the wall of the small intestine secrete an alkaline fluid, the succus entericus. This contains several ferments—enterokinase, erepsin, the nucleases and certain sugar-splitting enzymes. While enterokinase is classed among the ferments, its chief duty is that of converting inactive trypsinogen into trypsin. It appears in response to the flow of the pancreatic juices into the intestine. Erepsin, a proteolytic ferment found in the mucosa as well as the intestinal juices, does not act on the native proteins but attacks their disintegration products, the proteoses, peptones and polypeptids, and reduces these to amino-acids. The nucleases complete the action of pepsin and trypsin on nucleoproteids, and by their combined action split nucleic acid into phosphoric acid and certain radicles; the latter are absorbed as such and undergo further digestion by tissue ferments. The ferments of the succus entericus which act on the sugars are sucrase, which splits cane sugar into glucose and fructose, maltase, which hydrolyzes maltose to glucose, and lactase, which converts lactose into glucose and galactose. This last ferment is abundant in the intestines of sucklings. In addition to these ferments, the succus entericus contains an abundance of mucus which favors the passage of the intestinal contents.

The movements of the intestine not only aid digestion, but they also accomplish the propulsion of the intestinal contents. These movements are of two types in the small intestine. Each segment undergoes rhythmic contractions alternating with relaxation, which pendulum movements, as they are called, tend to subdivide repeatedly and again unite the intestinal mass. This causes a thorough kneading and mixing of the chyme with the digestive fluids, and in addition it brings the villi into more intimate contact with the products of digestion, thus facilitating absorption. The other movement is peristalsis, which by a series of wave-like contractions of varying length serves to carry forward the intestinal contents, at first rapidly and later, as the ileum is reached, more slowly. The movements of the colon are similar in character to the "rush" movements of the small intestine, but they are slower and much less frequent.

In this onward progress of the intestinal contents from twenty-five to thirty hours are required for the food to traverse the entire tract. While the large intestine is only about one-sixth the length of the small intestine, it retains its contents nearly three times as long. The chyme passes the ileocecal sphincter and reaches the large intestine in a liquid or semiliquid state. Through a series of peristaltic and antiperistaltic waves it is churned back and forth in the cecum and ascending colon, during which time a great part of the contained water is absorbed. It is then pushed forward to the transverse colon, where it remains a much longer time. Its further passage, which is by several stages, is accomplished at intervals by a few strong propulsive waves, each of which moves the entire mass. As the time for evacuation arrives, the fecal mass reaches the sigmoid flexure and rectum, and by its presence produces the stimuli which lead to defecation. Discussion of the act of defecation will be reserved for the chapter on Constipation.

The peristaltic waves which accomplish this movement of the intestinal contents occur in such a rhythmic manner as to suggest the controlling influence of a pacemaker. These contractions appear on stimulation of any segment of the intestine, or they may be produced by nervous influences arising elsewhere. Thus we are forced to recognize that in addition to the myogenic origin of intestinal movement, there is an independent neurogenic factor within the intestinal wall which exerts a controlling influence.

ABSORPTION

Nutritive materials (except water) are absorbed almost entirely from the small intestine. The products of carbohydrate digestion, chiefly glucose, with small amounts of fructose and galactose, are absorbed by the capillaries of the intestinal villi. These sugars pass by way of the portal blood to the liver, where they are converted into glycogen and stored as such, later to be reconverted into glucose according to the demands of the organism.

Proteins are absorbed in the form of amino-acids. These building stones, as they are called, pass through the intestinal wall directly to the blood stream; when they reach the tissues, they are quickly taken up by the cells. Of the sixteen or eighteen amino-acids which may be offered to the cell, it chooses such as are necessary to the building of those proteins peculiar to its own cell structure and discards the others. Other more highly organized nitrogenous bodies may occasionally gain access to the circulation, but they should be regarded as accidental invaders and the potential cause of profound disturbances.

Fat before absorption must be split into glycerol and fatty acids. Glycerol is immediately absorbed, while fatty acids unite with the bases of the intestinal fluids to form soaps. The alkali soaps formed in this process are soluble in water, but those of calcium and magnesium require the presence of bile for their solution; hence, the great importance of bile. During absorption the soaps meet again with glycerol and are immediately resynthesized into fat by the cells of the intestinal villi. This fat is taken up by the lacteals; finally, by means of the thoracic duct, it gains access to the general blood stream. About 40 per cent of the absorbed fat never reaches the thoracic duct, and the assumption is that this quota is either utilized en route or that by another route it finds immediate access to the blood stream. The latter assumption is probably correct.

The mechanism by which these nutritive substances find their way through the intestinal wall has been the subject of much discussion. It is evident that they do not simply leak through. Undoubtedly physicochemical processes, such as osmosis, dialysis and similar factors, play important rôles, but it is equally clear that there are also certain determining forces peculiar to the functional activity of the intestinal cells themselves.

Everyone who is interested in the physiology of digestion should read Pawlow's book which describes his brilliant studies in this field.[5] The chemistry of digestion is well covered in Hawk's "Physiological Chemistry."[9]

The gastric response to various foods, as well as to psychic influences, has been made the subject of exhaustive investigation by Hawk and his co-workers, and has been described in a series of articles published in the *American Journal of Physiology.*[10] A summary of our present knowledge in this field with a critical discussion appears in a recent article by Carlson.[7]

The mechanics of the digestive tract—an important and neglected subject—has been interestingly described in a monograph by Alvarez.[8]

COMPOSITION OF THE FECES

It is a popular fallacy that the feces consist of unabsorbed food residues. This is far from true; they consist in large part of intestinal secretions and excretions, of cellular material from the intestinal walls, of bacteria and (except in diarrhea) only in small part of food residues. It is interesting that the nitrogen content of the feces is relatively independent of the diet. It is as a rule the same whether the person takes large quantities of meat or confines his diet to rice.[11] Evidently, the fecal nitrogen comes largely from the secretions which are poured into the intestines. Mosenthal,[12] in his studies of the succus entericus of isolated intestinal loops, concluded that these secretions contain in all from 300 to 400 per cent of the nitrogen of the feces, and that obviously a large part of this is reabsorbed. The bacteria of the intestines probably secure a large part or all of their nitrogen from these secretions. They furnish in their dead bodies about half the nitrogen of the feces. The extent to which the bodies of bacteria contribute to the bulk of the feces has been variously estimated up to 30 per cent. Lusk[13] quotes the following table by Lissauer.

Table 1.—*Extent to Which Bodies of Bacteria Contribute to Bulk of Feces**

	Food	Percentage of Dry Bacterial Substances in Dry Fecal Material
In man	Meat	4.3
	Mixed	8.7
	Vegetable	10.5
In dogs	Meat	5.4
	Potatoes and bread	7.6
In rabbits		1.0
In cows		16.7

* This table by Lissauer is quoted by Lusk.

Concentrated foods, such as milk, cheese, eggs, meat and white bread are completely digested and are absorbed almost in toto; therefore they leave little residue. When large amounts of fruits and vegetables are eaten, however, there remains a rather large residue of undigestible cellulose, which undergoes fermentation, and, through the absorption of water, gives to the bowel content the proper bulk and consistency.

The physical characteristics as well as the composition of the feces can be determined in part by the nature of the diet, but it is a mistake to assume that the residues from different meals can be sharply divided and recognized in the feces. Alvarez and Freedlander[14] found that minute glass beads given with the food did not all pass through the intestinal tract at the same rate of speed; some went through rapidly and others required a week or more to pass. Evidently any given specimen of feces may contain residues of food eaten a week or more previously. The average individual excretes from 100 to 150 Gm. of feces, which amount is sometimes doubled or still further increased by the ingestion of large quantities of vegetables and fruits. The consistency and other physical characteristics of the feces in their relationship to the movement of the bowels will be discussed in the chapter on Constipation.

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CHAPTER III

NUTRITIONAL FACTORS OF FUNDAMENTAL IMPORTANCE

FUEL REQUIREMENT

To determine a person's fuel requirement is today merely a question of simplified mathematics. His basal metabolism can be predicted with a high degree of accuracy, and the influence of work can be estimated with a precision which is only a little less exact. The total energy liberated per hour or per day by a man (or woman) of a given age, height and weight while engaged in known work or activity can, with the experience tables of numerous investigators before us, be foretold with ease and accuracy.

Such estimates are made by taking as the starting point, (*a*) the basal metabolism, and adding thereto (*b*) the calories required to cover the activities or the work in which the person is engaged and (*c*) a certain increment to meet the specific dynamic action of food—the "cost of digestion." The influence of cold in stimulating metabolism need not under ordinary circumstances be considered, since the protective influence of man's clothing largely prevents the operation of this factor. If he is at rest in bed, obviously the influence of work too can be omitted.

Basal metabolism was discussed in Chapter I. It was explained there that the basal metabolic rate is directly proportionate to surface area, or to some other factor such as protoplasmic mass, which in itself is proportionate to surface area, and that for accurate measurement body surface should be taken as the criterion.

Surface Area.—Several formulas have been devised for estimating surface area; the most accurate and the one now in general use is Du Bois'[1] "height-weight" formula. From this formula Du Bois devised the chart shown in figure 1. The vertical lines represent height and the horizontal lines weight. The point where these lines intersect is located, and the proximity of this point to the nearest curved line will give the surface area. Since only one decimal point is given in the chart, it is necessary to estimate the second decimal. Intervening curved lines, such as would locate the second decimal point, are purposely omitted, since, as Du Bois[2] states, the surface area method is not accurate to the second decimal place, and such intervening lines would give a false idea of accuracy. The chart as constructed is sufficiently accurate. Boothby and Sandiford,[3] in their studies of basal metabolism, have concluded that Du Bois' "height-weight" formula offers the most accurate method for determining surface area, and from this formula they have devised the nomographic chart which appears in the chapter on Diabetes.

TABLE 1.—*Constants for Computing Surface Area* ($K\sqrt[3]{w^2}$) *(Benedict and Talbot)*

Boys		Girls	
Body Weight (without Clothing)	Value of Constant "K"	Body Weight (without Clothing)	Value of Constant "K"
Up to 6 Kg..................	10.0	Up to 6 Kg..................	10.1
6 to 15 Kg..................	10.6	6 to 10 Kg..................	10.6
15 to 25 Kg..................	11.2	10 to 20 Kg..................	10.8
25 to 40 Kg..................	11.5	20 to 40 Kg	11.1

TABLE 2.—*Estimated Body Surfaces for Body Weights from 3 to 40 Kg. (Benedict and Talbot)*

Body Weight (without Clothing), Kilograms	Surface* Estimated for Boys, Sq. M.	Surface* Estimated for Girls, Sq. M.	Body Weight (without Clothing), Kilograms	Surface* Estimated for Boys, Sq. M.	Surface* Estimated for Girls, Sq. M.	Body Weight (without Clothing), Kilograms	Surface* Estimated for Boys, Sq. M.	Surface* Estimated for Girls, Sq. M.
3	0.208	0.210	16	0.711	0.686	29	1.086	1.048
4	0.252	0.255	17	0.740	0.714	30	1.110	1.072
5	0.292	0.295	18	0.769	0.742	31	1.134	1.095
6	0.330	0.333	19	0.797	0.769	32	1.159	1.119
7	0.388	0.388	20	0.825	0.796	33	1.183	1.142
8	0.424	0.424	21	0.853	0.845	34	1.207	1.164
9	0.459	0.459	22	0.879	0.872	35	1.230	1.188
10	0.492	0.492	23	0.906	0.898	36	1.254	1.210
11	0.524	0.534	24	0.932	0.924	37	1.277	1.233
12	0.556	0.566	25	0.958	0.949	38	1.300	1.255
13	0.586	0.597	26	1.009	0.974	39	1.323	1.277
14	0.616	0.627	27	1.035	0.999	40	1.345	1.298
15	0.645	0.657	28	1.060	1.024			

* Surfaces estimated, using formula $K\sqrt[3]{w^2}$; for values of K as given in Table 1 for the different weight ranges.

Du Bois states that his "height-weight" formula can be applied with accuracy only to adults and to children whose weight is over 20 Kg. (44 pounds). He suggests for very small children and infants the adoption of the figures given by Benedict and Talbot.[4] These investigators have found that the Lissauer formula ($10.3\sqrt[3]{w^2}$) is sufficiently accurate for children, provided the value of the constant (10.3) is changed according to the age of the child. They propose the acceptance of this formula with the use of the constants given in Table 1. By this means these authors have computed the surface area of children of varying body weight and have arranged the results as shown in Table 2.

Basal Metabolic Rate.—After surface area has been determined, it becomes necessary to find the basal metabolic rate for the subject's age and sex. The variation in rate according to age and sex has been studied by a number of investigators. The "sage standards"[5] of metabolism as given by Aub and Du Bois are generally accepted. These authors show that the rate per square meter increases rapidly from birth until about 5 years of age, after which there is a rather precipitous fall to 20 years, and then a gradual but constant decline. Table 3 gives the basal metabolic rate for the several adult age groups.

TABLE 3.—*Calories per Square Meter of Body Surface per Hour (Height-weight Formula) (Aub and Du Bois)*

Age, Years	Males	Females
14–16	46.0	43.0
16–18	43.0	40.0
18–20	41.0	38.0
20–30	39.5	37.0
30–40	39.5	36.5
40–50	38.5	36.0
50–60	37.5	35.0
60–70	36.5	34.0
70–80	35.5	33.0

The truth of the surface area law has been called into question by Benedict.[6] This investigator, after an elaborate series of statistical studies, together with Harris, has devised the following "prediction formula" for basal metabolism:

Where, h = total heat production in 24 hours.
w = weight in kilograms,
s = stature in centimeters,
and a = age in years, the formula may be written:
for men:

$$h = +66.473 + 13.7516w + 5.0033s - 6.7550a$$

for women:

$$h = +655.0955 + 9.5634w + 1.8496s - 4.6756a$$

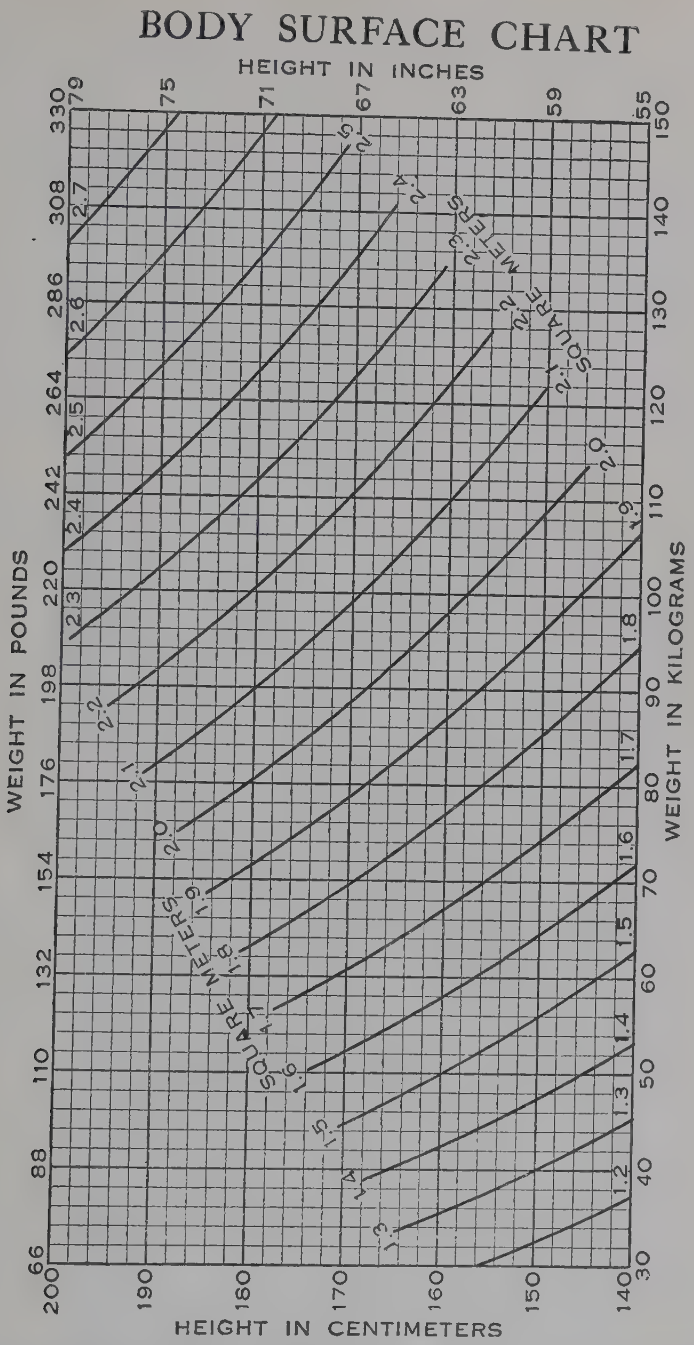

CHART 1.—Du Bois' chart for Determining Surface Area of Man in Square Meters from Weight in Kilograms (Wt.) and Height in Centimeters (Ht.) According to the Formula:

$$\text{Area (sq. cm.)} = \text{Wt.}^{0.425} \times \text{Ht.}^{0.725} \times 71.84.$$

This formula offers a convenient and accurate means for predicting basal metabolism provided the subject is not too old and that he does not deviate too far from the average standard of body build. Boothby and Sandiford[7] show in an ingenious manner that the prediction formula can be used to prove the accuracy of Du Bois' method, and conclude that surface area is more directly proportionate to basal metabolic rate than is any other measurable factor. The consensus of opinion seems to be that for an individual of average height and weight the Harris-Benedict prediction formula will furnish an accurate estimate of basal metabolism, but that the Du Bois surface area method, although its results are often a little too high (about 4 per cent), will give more uniformly dependable figures, especially when subjects of unusual size are considered.

It should be reiterated that the foregoing statements concerning the basal metabolic rate refer to the ordinary, fairly well nourished person about fourteen hours after a meal, and that the figures given do not apply during prolonged starvation or in states of marked inanition. It is a fact of great importance to the clinician that partial inanition reduces heat production as much as does complete starvation; this reduction may be as great as 30 per cent. Lusk,[8] in an excellent review of this subject, suggests that there is a biologic adaptation to lowered energy intake, the object of which is apparently to conserve body fat. Nor do these figures hold good during fever or in certain other diseases notably the thyreopathies. This will be discussed in subsequent chapters.

The Increment of Exercise and Work.—In estimating a person's fuel requirements, there must be added to the number of calories necessary for basal metabolism a sufficient number of calories to take care of his ordinary activities and of any work in which he is engaged. For instance, sitting on a chair or the mere act of standing materially increases the metabolic rate; this increase has been estimated as 10 per cent of the basal figure. The act of getting out of bed and dressing is estimated as adding about 150 calories. Walking along a level road at the rate of three miles an hour (the maximum of economic velocity) necessitates a metabolic increase of 1.1 calorie an hour for each pound of body moved. This applies to extra weight carried in the same measure as it applies to body weight.

Carpenter, in his painstaking studies, found that the work of typewriting resulted in an increase of from 30 to 70 per cent in the total metabolism above that of the resting periods, an average increase of about 50 per cent. The variations noted in different persons was due to differences in facility and therefore in effort. Tables 4, 5 and 6 give the number of extra calories required per hour by men and women to meet the demands on energy made by various occupations.

TABLE 4.—*Extra Calories per Hour Attributable to Occupations of Men (Lusk)**

Occupation of Men	Extra Calories of Metabolism per Hour Due to Occupation
Tailor	44
Bookbinder	81
Shoemaker	90
Metal worker, filing and hammering	141
Painter of furniture	145
Carpenter, making a table	164
Stonemason, chiseling tombstone	300
Man sawing wood	378

* This table and Table 5 are taken from Lusk, G.: Science of Nutrition, Ed. 3 Philadelphia, W. B. Saunders Company, 1921 (table of extra calories per hour).

TABLE 5.—*Extra Calories per Hour Attributable to Occupations of Women (Lusk)*

Occupation of Women	Extra Calories of Metabolism per Hour Due to Occupation
Seamstress, needle work	6
Typist, 50 words per minute	24
Seamstress, using sewing machine	57
Bookbinder	63
Housemaid (moderate work*)	81
Laundress (moderate work*)	124
Housemaid (hard work*)	157
Laundress (hard work)	214

* Cleaning windows and floors, scouring knives, forks and spoons, scouring copper and iron pots.

Table 6.—*Average Energy (Heat) Output during Experiments with a Woman Engaged in Different Household Tasks**

Character of Experiment	Extra Calories of Metabolism per Hour Due to Occupation
Resting	00.0 calories
Knitting	10.1
Crocheting	8.3
Sewing	
Scalloping	10.2
Running	7.5
Hemming	10.3
Hemming and running	9.8
Darning	8.0
Average for sewing	9.4
Dressing infant (model)	23.6
Sweeping floor	40.1
Washing floor	29.0
Washing towels	49.6
Ironing towels	24.3
Dishwashing	
Table 65 cm. high	30.0
Table 100 cm. high	24.4
Table 85 cm. high	20.3
Average for dishwashing	24.8

* This table is taken from Langworthy, C. F., and Barott, H. G.: Energy Expenditure in Household Tasks, Am. J. Physiol. **52**: 400, 1920.

The Increment of Specific Dynamic Action of Food.—Since the mere ingestion and assimulation of food, notably of protein, increases the metabolic rate, the estimated amount of this increase must be added to the total metabolism. The extent to which this specific dynamic action is felt depends on the amount and kind of food eaten. The influence of meat is greatest, that of the other foods considerably less. This is illustrated by the figures in Tables 7, and 8, taken from Du Bois.[9]

If a person is on a mere maintenance diet with little meat, the increase in metabolism due to specific dynamic action may be only 3 or 4 per cent. When protein is present in the diet in such small amounts that the component amino-acids are used solely for the replacement of tissue lost by wear and tear, no specific dynamic action is exerted.[10] At the other extreme, a full dietary containing a great deal of meat may cause an increase of from 12 to 18 per cent. Benedict and Carpenter[11] have shown that a liberal meal of beefsteak may increase the rate as much as 33 per cent. As a rule, in accounting for the specific dynamic action of food, the physician will not go far wrong if to the basal metabolism plus the metabolism of exercise he adds about 10 per cent.

Table 7.—*Experiments in Sage Calorimeter on Increased Heat Production after Ingestion of Glucose and Protein*

		Fuel Value, Calories	Estimated Increase in Heat, Calories	Heat Increase Divided by Fuel Value (Per Cent)
E. F. D. B.	100 Gm. glucose............	370	25.0	6.7
E. F. D. B.	200 Gm. glucose............	740	36.0	4.9
L. C. M.	200 Gm. glucose............	740	44.8	6.1
E. F. D. B.	Casein and egg albumen, 10.5 Gm. nitrogen..............	278	49.9	17.8

Table 8.—*Summary of Calorimeter Experiments on Effect of Mixed Diet in Increasing Heat Production*

Subject	Meals	Fuel Value, Calories	Total Nitrogen, Gm.	Calories, Per Cent			Estimated Increase in Heat, Calories*	Cost of Digestion, Heat Increase Divided by Fuel Value
				Protein	Fat	Carbohydrate		
	Chair Calorimeter Nutrition Laboratory							
H. L. H.	Moderate supper.....	1,731	7.3	11	21	68	84.0*	4.9
A. L. L.	Heavy breakfast.....	2,720	10.9	10	52	38	198.0*	7.3
H. R. D.	Heavy breakfast.....	3,311	14.6	12	43	45	226.0*	6.8
	Unit Respiration Apparatus Nutrition Laboratory							
A. F.	Small breakfast	468	3.0	17	52	31	19.0	4.0

* Increase actually found plus increase estimated for periods between ingestion of food and start of experiment and for period of from one to three hours after some of the experiments.

An Example.—To illustrate, the daily fuel needs of a man, aged 40, 5 feet 10 inches (180 cm.) tall, weighing 155 pounds (70 Kg.) and working eight hours as a shoemaker could be predicted as follows:

Table 9.—*Energy Requirement of a Shoemaker of* 40 *Years,* 5 *Feet* 10 *Inches Tall* (180 *Cm.*) *Weighing* 155 *Lb.* (70 *Kg.*)

Basal metabolism: Surface area (180 cm. 70 kg) = 1.95 sq. m. Rate per hour per square meter for man 39.5 calories. Total basal metabolism for twenty-four hours (1.9 by 39.5 by 24) =..................................	1,801
Extra calories attributable to occupation (for shoemaker per hour 90 calories working eight hours—90 by 8) =..	720
Extra calories attributable to an additional eight hours of ordinary activity (sitting on chair, walking to work, etc.) estimated =......................	500
	3,021
Increment (10 per cent) for specific dynamic action of food.................	302
Total food requirement in colories..............................	3,323

Simpler Methods.—The methods and formulas given above for evaluating separately many of the factors which influence a person's metabolism and for predicting with a high degree of precision his fuel requirements are for the majority of persons unnecessarily elaborate. In diabetes mellitus, less often in nephritis or obesity, and rarely in other diseases such methods are applicable. However shorter methods will ordinarily suffice. Such accuracy in the prescription of the food presupposes similar accuracy in its preparation and consumption, a condition which it is difficult to secure except with the aid of a specially equipped diet kitchen. Even the best of hospital kitchens, when not connected with a metabolism ward, are not prepared for such precision. Aside from the question of unnecessary labor, I think it important not to make a show of precision which circumstances do not warrant.

In those diseases in which accuracy of metabolic control is required, it usually suffices to estimate the patient's twenty-four hour basal metabolism by means of the Du Bois surface area chart or the Harris-Benedict prediction formula, and to add thereto a figure which is an approximately correct measure of the other factors which influence his metabolism. Under other circumstances, it often suffices, to determine from tables already prepared that a clerical worker, for example, needs 2,700 calories, or a carpenter 3,500 calories, and to adopt without further question the appropriate figures. For such estimates of the total fuel requirements of people engaged in various occupations, the figures of Becker and Hämäläinen[12] are generally accepted (Table 10). They presuppose a working day of eight hours.

TABLE 10.—*Total Energy Requirement Every Twenty-Four Hours Including Eight Hours of Labor, as Estimated by Becker and Hämäläinen*

Men	Calories
Tailors	2,600–2,800
Bookbinders	3,000
Shoemakers	3,100
Metal workers	3,400–3,500
Painters	3,500–3,600
Cabinet makers	3,500–3,600
Stone masons	4,700–5,200
Wood sawers	5,500–6,000
Women	
Seamstress (with hand needle)	2,000
Seamstress (with machine)	2,100–2,300
Bookbinder	2,100–2,300
Household servants	2,500–3,200
Washerwomen	2,900–3,700

TABLE 11.—*Dietary Requirements Assembled by Statistical Means as Reported by Lusk*

	Calories	Author
Farmers in Connecticut	3,410	Atwater
Farmers in Vermont	3,635	Atwater
Farmers in New York	3,785	Atwater
Farmers in Mexico	3,435	Atwater
Farmers in Italy	3,506	Atwater
Farmers in Finland	3,474	Sundstrom
Maine lumbermen	8,083	Woods and Mansfield

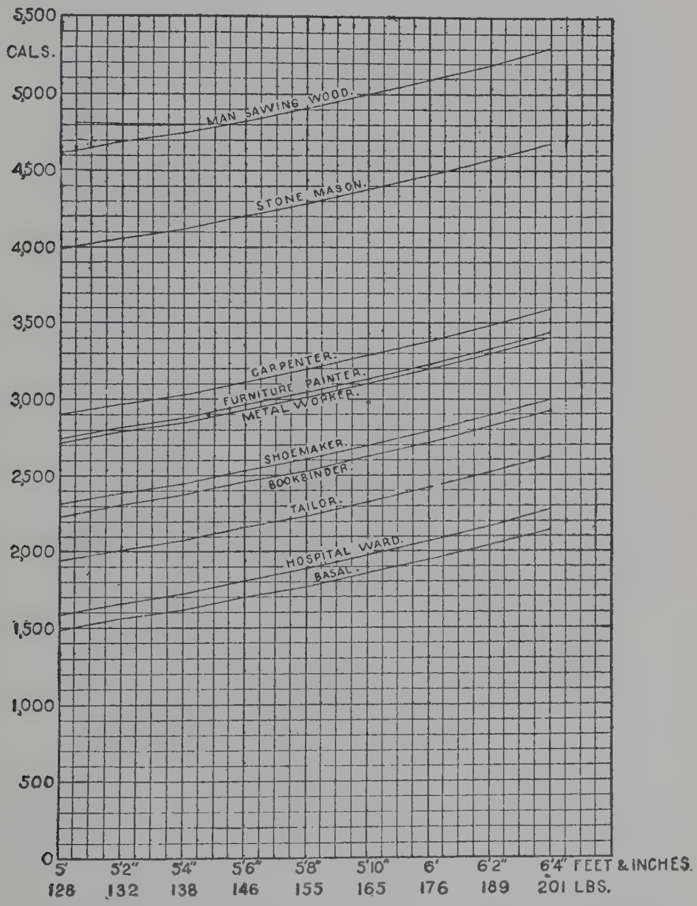

CHART 2.—Metabolism in calories per day of men engaged for eight hours in various industrial pursuits. (From Lusk in J. A. M. A. **70**: 823, 1918.)

Lusk,[13] in a paper published during the World War, illustrated in graphic charts the total caloric needs of different classes of people engaged in various activities. From these charts can be determined at a glance the twenty-four hour metabolism of a man or woman who is engaged for eight hours of the day in the performance of a certain kind of work. In reading these charts it is not necessary to correlate height and weight, since this author has shown that between the ages of 20 and 50 a man's weight may vary as much as 10 per cent without altering his metabolism more than 5 per cent. In these charts this factor must be counted only when the weight varies markedly from the normal.

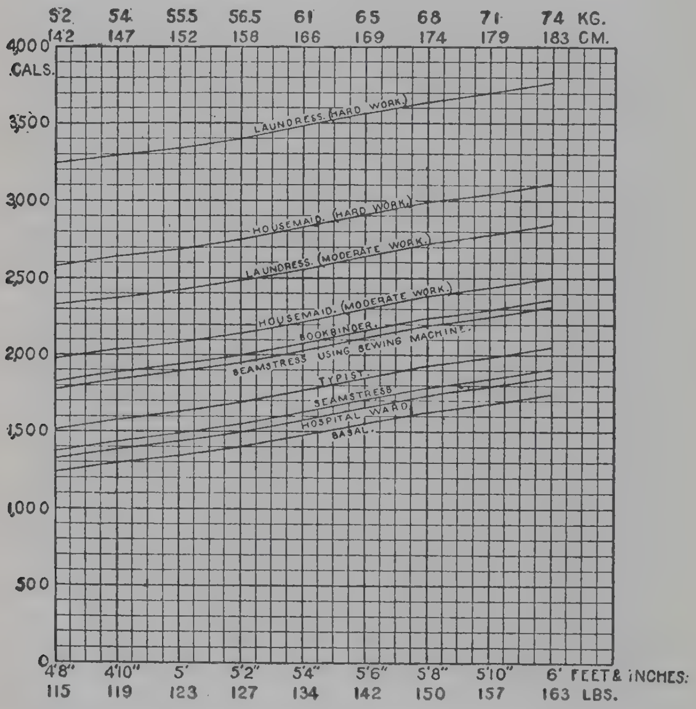

CHART 3.—Metabolism in calories per day of women engaged for eight hours in various industrial pursuits. (From Lusk in J. A. M. A. **70**: 823, 1918.)

Children.—The statement made at the beginning of this chapter concerning the accuracy of metabolic prediction does not apply to the active child; for no one has yet been able to measure accurately the enormous amount of energy put forth by a child, especially by an active boy. Not only is his basal metabolic rate proportionately higher (about 25 per cent), but he burns up an enormous amount of fuel through his almost incessant muscular activity. The same, to a less extent, can be said of a girl. The total metabolism of a boy of 12 or 14 years often exceeds that of his father. Gephart's[14] observation of the food consumption of boys at a private boarding school showed that their food intake frequently reached 5,000 calories. Benedict and Talbot,[15] in their studies of the metabolism of growing children, state: "The activities are, it is true, enormous. The food consumption is proportionately great." The chart which follows represents Lusk's estimate of the metabolism of a boy of varying degrees of activity.

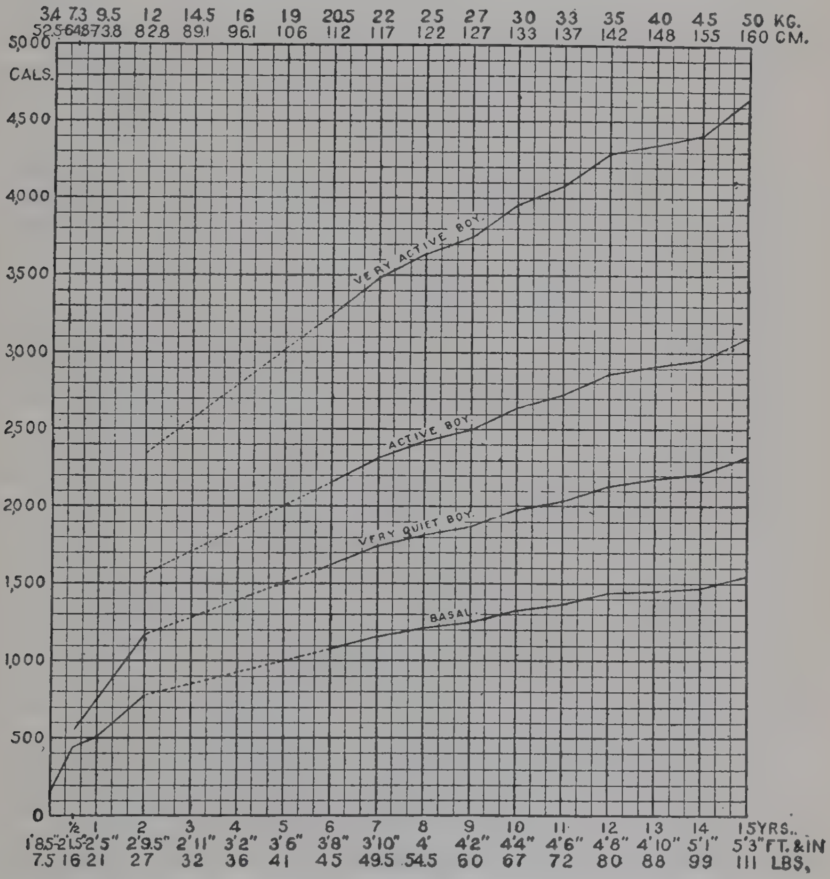

CHART 4.—Metabolism in calories per day of boys from birth to 15 years of age. (From Lusk in J. A. M. A. 70: 822, 1918.)

Kind of Food.—The foodstuff which best meets these requirements for energy was discussed in an earlier chapter. It was there explained that carbohydrate furnishes the energy for the accomplishment of work, and that labor can be more efficiently performed when the diet consists largely of carbohydrates. Protein metabolism is not appreciably increased by muscular activity, and little if any of the protein of food (except that part which is converted into glucose) can be used for muscular work.[16] In case of need, fat will furnish the fuel for muscle energy, but probably in an uneconomical manner; some of its energy is undoubtedly lost by its conversion into glucose or into some related body. From a physiologic standpoint, it is of great importance to know that carbohydrate is the most economical source of energy, and that as a protein sparer it is much superior to fat.

A complete discussion of man's fuel requirements may be found in Lusk's "Science of Nutrition.[11]

THE PROTEIN PROBLEM

How much protein does a person need? What is the smallest intake compatible with the assured preservation of health and vigor? This has been a much discussed question, and in order to answer it in the light of present-day knowledge, three points must be considered (*a*) the quality or biologic value of the protein consumed, (*b*) the distinction between minimum and optimum as applied to protein intake and (*c*) the criterion by which "health and vigor" are judged, whether by a sense of well-being with the efficient accomplishment of work experienced during a limited period or by the preservation of youthful vigor with comparative freedom from disease during an appreciably large fraction of the person's life. These considerations will be discussed below.

Biologic Values.—An important truth which was not fully appreciated in the earlier discussions of man's protein needs is the fact that no two proteins are exactly alike, and that because of differences in structure they may vary widely in nutritive value. Proteins consist of chains or groups of amino-acids linked together, and it is the kind and number of these component amino-acids, or building stones as they are called, which determine the nutritive value of a protein. At one extreme of nutritive value is gelatin which, because of its failure to supply the three amino-acids—tryptophan, tyrosin and cystin—is an incomplete protein. When gelatin is taken as the sole food protein, even in large amounts, nutritive failure results. It would appear, for example, that the organism uses tryptophan for the manufacture of hormones or other vitally important bodies (thyroxin), and that because of this need this building stone is essential to life. For similar reasons the other amino-acids are equally essential. When, however, these three missing amino-acids in sufficient amounts are added to the gelatin diet, then this nutritional fault disappears and nitrogen equilibrium can be established.

At the other extreme is the milk protein casein. This supplies in full measure all of the amino-acids necessary to life, and therefore growth and full vigor can be maintained even when this foodstuff is the sole protein component of the diet.

The term "biologic value" has been adopted to express this nutritive suitability, and proteins are classed as of high or low biologic value according to the completeness with which they supply all of the amino-acids necessary for the construction of the animal's own tissues.

At the top of the list, among those of unusually high value, stand the proteins of milk; those of meat are also of high biologic value. In comparing the nutritive value of kidney, liver and muscle of the ox, McCollum and his co-workers found that the kidney is superior to the others, with the liver second and muscle meats third.

Of lower biologic value are the plant proteins, such as those of the cereal grains, wheat, corn, oat, rice, peas, and beans. Among these, wheat ranks highest. It would appear that each of these seeds contains all of the necessary amino-acids, but that in each one or more of these building stones are present in such inadequate amounts as to render the entire protein of low value. Just as a chain is as strong as its weakest link, so is a protein as valuable as the building stone which it provides in smallest amount. When taken alone as the sole source of protein, none of these grains will long maintain health and vigor. They must be supplemented by proteins from a different source.

This supplementary value of a protein is of great importance. A given protein, because of its failure to supply one or more building stones properly, may be of low biologic value; but it may still be useful as a food because when it is supplemented by another protein which provides the missing amino-acids, the mixture of the two will be of high biologic value. It has been found that two cereal grains do not supplement one another satisfactorily, but that proteins from a widely different source must supplement these grains. A good supplementary relationship has been found to exist occasionally between a cereal grain and a legume seed, notably between wheat and peas: a mixture of corn and peas is not so valuable. Meat proteins enhance the value of the cereal grains in the most satisfactory manner; milk runs a close second.

In determining the biologic value of a protein, it is not possible to differentiate the several physiologic purposes for which this protein may be used. Whether it is used for growth, for maintenance, or for the production of milk, it must always be given the same value. This is a complex problem, however, and one concerning which there may be more information in the future.

Before consideration can be given to the amount of protein needed by man, there must be a full appreciation of the importance of biologic values and of the supplementary properties which the various proteins exhibit toward one another. To reach the highest degree of physiologic economy, it is essential that those proteins of the diet which are of low biologic value, such as those of the cereal grains, be supplemented by proteins of high biologic value and of good supplementary worth, such as are found in meat or milk. The painstaking studies in this field by McCollum and his coworkers, by Osborne, by Mendel, and by others, are described by McCollum in his book on nutrition.[18] The reader is referred also to the lectures of Mendel[19] and to a recent résumé of this subject by Mitchell.[20]

Minimum and Optimum.—There is wide divergence of opinion concerning the minimum amount of protein which will maintain health and vigor. Shall we accept as correct that amount of food which the race has instinctively chosen, or shall we adopt the figure indicated by experimental studies? The pioneer physiologist Voit, after observing the amount of protein eaten by a large part of the population, concluded that for the average man weighing from 70 to 75 Kg. and engaged in ordinary activities, 118 Gm. represents the appropriate protein intake. Atwater arrived at a similar figure, 120 Gm. This estimate was universally accepted for a long time.

Then Professor Chittenden[21] made his studies of physiologic economy in nutrition. He experimented first on himself. He found that on a relatively low protein intake, about 40 Gm. daily, he enjoyed better health and greater vigor than ever before; his several minor ailments disappeared, and he could do better work. Similar studies were carried out on groups of volunteer Yale students and for a period of nine months on a squad of soldiers. These students and soldiers experienced exuberant health and vigor while on a relatively low protein intake. From these observations, Chittenden concluded that man habitually eats too much, especially too much protein, and that greater health and happiness can be maintained with a protein intake of approximately 50 Gm. daily.

Hindhede, who has been widely quoted, is another champion of physiologic economy in nutrition; independently, he has reached conclusions similar to those of Chittenden. He relates that he feels much better and can do better work when on a diet which contains no meat and comparatively little protein. Other physiologists also have come to accept Chittenden's conclusions. Lusk[22] states that he is reliably informed that the physiologist Rubner, who before the World War was violently opposed to restricted protein intake, has recently modified his views and has become a convert to the more limited diet. On the other hand, Friedrich Müller[23] has recently told of the marked decrease in mental and bodily efficiency, with diminished resistance to disease, which was experienced in Germany during the war; the mortality from tuberculosis was enormously increased. A prominent feature of this war-time ration was protein deprivation.

Lusk,[24] in discussing Chittenden's views, makes this significant statement: "It remains to be seen whether this quantity of protein in the ration (40 Gm.), which is not greater than the body would metabolize in starvation, is advisable as a program for the whole of one's adult life." In concluding this discussion, he expresses the opinion that there is no reason why people living in a cool climate should not, according to the dictates of appetite, continue to ingest about 100 Gm. of protein daily.

McCollum favors the more liberal protein allowance, and through his experiments on animals throws a new light on this problem. McCollum, Simmonds and Parsons[25] restricted young mice to a diet which, as regards the protein content, was faulty in various degrees. It was found that on such a diet a young animal could be raised to maturity and for a time maintained in comparative health—but for a time only—for on this diet the animal soon showed evidences of disease and early senility. These experimenters, after extensive observations on large groups of young rats, concluded that a diet which deviated even in slight degrees from the optimal in protein content resulted in disturbances of the nervous system and otherwise affected the entire life of the animal.

McCollum[26] calls attention to the fact that a diet may be grossly at fault and yet produce no recognizable damage if adhered to for only a relatively brief fraction of the animal's life—for not more than 5 per cent of his span of life. If the nutritive fault is continued longer, intercurrent disease, lessened fertility and early senility occur. He expresses the opinion that the nine months' period of Chittenden's observations on students and soldiers, a period which represents only about 1 per cent of man's normal span of life, was entirely too short to warrant deductions of far-reaching character. What would have been the result had the restricted diet been adhered to through a period of several years? Reasoning from the animal experiments reported above, one would conclude that after a time these individuals would have exhibited so-called functional nervous disease and lessened efficiency, and that they would have aged early.

It should be emphasized here that this discussion does not concern the harmful influence of high protein diets on people whose kidneys are diseased; nor is it concerned with the ill effects which may follow the ingestion of excessive amounts of protein by healthy persons. McCollum[27] produced nephritis in rats by means of a food mixture which contained from 30 to 40 per cent protein; Newburgh[28] caused this disease in rabbits who were fed on a diet consisting largely of meat; but in each of these two series the protein consumed was excessive, and in the latter series the carnivorous character of the diet was grossly abnormal. Opposed to these results were those of Jackson and Riggs,[29] who concluded: "By feeding very high protein diets over a period of ten to twenty months, or about a third of the rat's life, we have been unable to produce in these animals any recognizable nephritis."

It is of interest to consider the reasons which actuated the proponents of the low protein diet. Chittenden was induced to practice protein economy partly through a desire to spare the kidneys, liver and other organs. Is this necessary? The kidney, as is well known, has a large factor of safety. It is said that two-thirds or more of its parenchyma must be destroyed before loss of function results. There is reason for believing that the liver has a similar factor of safety. When these wide margins of safety are considered, one is led to regard as unnecessary the dietary restrictions which are intended to reduce their work to a minimum.

Chittenden was also influenced by the fear of absorption of protein decomposition products from the bowel. This phobia, which is an old one, is deeply embedded in the minds of many observant physicians. A great deal has been written on the subject, most of it based on vague, general impressions rather than on accurately controlled clinical observation. While this is still an open question, I think it must be admitted that no one has succeeded in proving that any definite disease results from the absorption of the products of protein decomposition. Alvarez[30] has recently reviewed the entire subject of intestinal autointoxication, so called, and one would conclude from the work reported by him that these fears are not well grounded. It would appear that bacterial invasion through the wall of the intestine rather than the absorption of chemical poisons is the chief cause of trouble. After summarizing the evidence against protein decomposition products, Alvarez gives the Scotch verdict "not proved," with an evident leaning toward "not guilty."

In honor of the more liberal side of the protein problem there is a clinical consideration which is too often overlooked. I have been impressed by the anemia shown by many patients who, from necessity or from a desire to become fashionably thin, have subjected themselves to rigid dietary restriction. Animal experimentation has proved that a diet which contains a liberal amount of meat is the best blood builder,[31] and one wonders whether an optimum protein intake is not, after all, good insurance against disease. Clinical experience shows that it is.

Reproductive activity and fertility are influenced by food. Slonaker and Card[32] found that pubescence, fertility and the menopause in mice were unfavorably influenced by a restricted diet. They conclude: "The addition of animal protein to the diet produced a reduction in sterility and an approach to normal conditions of pubescence, menopause and period of reproductive activity." MacLeod,[33] as the result of feeding experiments with rats, reported: "Experiments indicate improved reproduction and lactation when fresh meats in a mixed diet is increased from 10 grams per rat per week to 40 grams per rat per week." Benedict and his co-workers observed that a restricted diet in man definitely depresses sex instinct, even when it produces no other observable effect. They say "Our data indicate that nature demands a rather high metabolic level for the normal functioning of sex in man."[34]

Consider, too, the question of stamina. It has been suggested repeatedly, and with good reason, that the stimulus which a liberal protein diet gives to metabolism determines to a considerable degree the vigor of the individual and the stamina of the race.

Thus it would appear that the terms minimum and optimum as applied to diet are not synonymous, and that the smallest permissible intake is not necessarily the best. Meltzer[35] understood this when he said that as an engineer adds the factor of safety to his specifications when he builds a bridge, a similar factor of safety should be added in the diet. We may be able to get along happily and well, at least for a time, on a minimal protein intake, but the diet which promises greatest insurance against decay and disease is the one which carries with it a liberal factor of safety. This is the optimum diet.

Conclusion.—It seems fair, then, to conclude that the earlier estimates of man's protein needs were approximately correct, and that to enjoy sustained vigor and to experience his normal expectancy, man must eat a liberal quantity of good protein. By liberal is meant an amount in excess of his theoretic needs, such an amount as the race, in its long experience, has instinctively chosen—say, 100 Gm. daily, more or less. By good is meant proteins or protein mixtures which are of high biologic value, in which the proteins of meat or milk, preferably of both, find first place.

FOOD FACTORS OF UNKNOWN NATURE—VITAMINS

Introductory.—The animal is accustomed to derive his nourishment from fresh native foods, such as plants and the flesh of other animals. When he is made to live on purified, highly refined foods, nutritional failure results and characteristic disease often ensues. Certain essential factors of unknown chemical nature are lacking in this purified diet. At the present time five such factors are tentatively recognized. They are known as vitamins.

The history of vitamins goes back to the old-time sailing vessels, and to the scurvy from which their crews suffered. It was pointed out as early as 1747 that scurvy could be prevented if the sailors were given lemon juice or orange juice; about 1800, the frequency of this disease in the British navy was greatly lessened when lemon juice became a part of the regular ration. Thus it was proved that scurvy results from a lack of some substance which can be supplied by lemon juice. The next chapter in the history of vitamin deficiency concerns another disease, beriberi, which also accompanied the restricted ration of the sailor. This disease was the scourge of the Japanese navy until 1885, when, following the advice of Takaki, barley was substituted for a part of the polished rice which heretofore had formed the chief ration. By this simple change the Japanese brought about the almost complete disappearance of beriberi from their navy. Later, Eijkman described an illness in fowls similar to beriberi, and expressed the view that this disease is due to some hitherto unknown nutritive substance present in rice polishings, to which disorder he gave the name "nutritional polyneuritis."[36] It was found that the substance in question is soluble in water and that it belongs to none of the well known groups of foodstuffs. Subsequently, Funk claimed to have isolated this body, to which he gave the name "beriberi vitamin." He attributed pellagra, scurvy and rickets as well as beriberi to vitamin deficiency. To Funk is due the credit of bringing into the limelight this important question of deficiency diseases. In an attempt to reproduce beriberi in guinea-pigs by means of polished rice, Holst and Frölich found that instead of developing this disease the animals exhibited the characteristic symptoms of scurvy. Further experiments revealed the separate identity of the antineuritic and antiscorbutic principles, and indicated that both were lacking from this diet.

A vast amount of experimental work was done about this time on the feeding of young animals with purified foodstuffs, such as purified casein, starch and lard, to which was added an appropriate salt mixture. Such animals failed to grow. McCollum and Davis[37] found that young animals restricted to such a diet would grow well when butter fat or egg-yolk fat was added to the food, but not when olive oil or lard were the sole sources of fat. From this they concluded that certain fats contain a dietary essential not hitherto recognized. A little later Osborne and Mendel,[38] pursuing similar experiments with purified foodstuffs, found that young animals were retarded in growth and that older animals developed a characteristic disease of the eye when the diet did not contain fat. These investigators found that the addition of butter or cod liver oil to the diet permitted growth and prevented the development of the characteristic disease of the eye. These studies pointed to the existence of an important principle which is essential to growth.

Recently McCollum[39] has called attention to the fact that the disturbances in the metabolism of calcium and phosphorus which gives rise to rickets is prevented by a substance which is found in great abundance in cod liver oil. He suggests that rickets is a true deficiency disease due, among other causes, to the absence from the diet of yet another vitamin.

More recently, Evans and Bishop[40] have shown that fertility in mice is dependent on the presence in the diet of a vitamin distinct from those previously described.

This important subject of vitamins is an unfinished chapter, and much that has been written will no doubt undergo revision. From the observations briefly reported above as well as from the enormous mass of other experimental work, opinion today has so crystallized that five fairly well characterized vitamins are recognized. Attempts have been made to give these vitamins names which are suggestive of their physical properties or their physiologic action, such as "fat-soluble," "water-soluble," "antiophthalmic," "antineuritic," "antiscorbutic" or "antirachitic," but in the light of our present knowledge it seems best to adopt a simpler terminology—one which does not commit one to a premature description of physiologic action. The vitamin related to growth is called "vitamin A;" to beriberi, "vitamin B;" to scurvy, "vitamin C;" to rickets, "vitamin D;" and to gestation, "vitamin E."

Descriptive.—*Vitamin A* is essential to growth. This, however, is not its sole function, since the animal whose diet is deficient in this factor also shows, among other disturbances, greatly increased susceptibility to infection. This is especially evident in the eye, where infection superimposed on a dry conjunctiva leads to the characteristic disease, xerophthalmia or keratomalacia. If a little butter fat or other substance containing this vitamin is added to the diet, growth is promptly resumed; or if changes have occurred in the eye, these quickly disappear. Vitamin A deficiency probably renders all of the organs less resistant to infection.

Feeding experiments have proved the separate identity of vitamin A. It will not prevent beriberi in pigeons or scurvy in guinea-pigs. Likewise, it will neither cure rickets nor prevent the type of sterility described by Evans and Bishop.

Vitamin A is fat-soluble and can be extracted by means of ether and other fat solvents. It is found in abundance in milk, butter fat, egg yolk, and cod liver oil, and in smaller amounts in beef fat. It is fairly abundant in the organs of animals, but little is present in the muscles. It is found in rich abundance in the green leaves of plants, notably in spinach, alfalfa, lettuce, cabbage and cauliflower. Tomatoes are equally rich. In plants this vitamin is perhaps held in some loose combination with chlorophyl, which would explain its resistance to drying and to the action of fat solvents in the green leaf. When set free by the digestive juices, however, it is readily taken up by the body fats. This vitamin is lacking in vegetable oils, such as cotton seed, olive and almond oils and in lard.

The animal does not seem to have the power of manufacturing vitamin A, although it can store this substance in relatively large amounts. Thus, milk depends for its vitamin richness on the food of the cow. If the cow feeds in green pastures, her milk in this respect will be rich, but if on grain and other foods poor in vitamins, it will be correspondingly poor.

Vitamin A is moderately stable to heat if not exposed to oxidation. It will resist boiling for a time, but continued high temperatures plus exposure to oxygen leads to its rapid destruction. It would appear that in plant tissues it is a little more resistant to these destructive agencies.

The disturbances caused by lack of vitamin A will be discussed in the chapter on Deficiency Diseases.

Vitamin B.—Vitamin B also is concerned in growth, but the most graphic disorder to which it is related is polyneuritis. The typical forms of this are seen in the polyneuritis of fowls and in beriberi in man. Pigeons when fed solely on a diet of polished rice, will develop polyneuritis, become helpless and die. A most striking change is seen when such a bird, evidently within an hour or so of death, is given a few cubic centimeters of a watery extract of rice polishings or other substance rich in vitamin. Immediately, improvement is evident; within a few minutes the bird holds up his head; he pulls himself together, and in a short time he appears almost well. A similar thing has been observed in a polyneuritic dog. Helpless and unable to use his legs, such a dog within a few hours after the injection of neutralized tomato juice is able to walk again.[41] Patients with beriberi also exhibit definite though less striking improvement as soon as they receive food containing vitamin B.

It should be added that a direct causal relationship of vitamin B to beriberi is not yet universally accepted. Some other factor in combination with avitaminosis may play a rôle. In one way or another, however, vitamin B is concerned in the production of this disease.

Other equally important disturbances follow vitamin B deficiency. There is atrophy and congestion of the intestinal wall, chiefly in its upper portions, with loss of neuromuscular control. These gastrointestinal changes are accompanied by disturbances of secretion and impairment of assimilative powers, as well as by a breakdown of the normal defenses against bacterial invasion. A fundamental distinction is said to exist between the nervous and the alimentary manifestations of vitamin B deficiency. Whereas the former are probably due in large measure to functional disturbance, the latter evidently rest on widespread destruction of tissue.[42] From a clinical standpoint, the alimentary disturbances are of greater importance.

It is said also that this vitamin is a stimulant to metabolism and to certain of the endocrine glands, and that therefore its deficiency leads to endocrine imbalance.

Vitamin B is abundant in the yolk of the egg, in milk and in the leafy portion of green vegetables. Muscle meats are poor in this respect, but the heart, liver and kidney contain this vitamin in larger amounts. The whole grain of the cereals contains vitamin B in relatively large amounts, but the endosperm is poor in this substance; the more the grain is refined in the milling, the less vitamin will be contained in the product. This is particularly true of rice, in which the pure endosperm contains practically no vitamin. Since milling removes from the wheat a large part of its vitamin B, the suggestion has been made that we eat the whole grain or at least less highly milled flour. The objection to this is that flour and other cereal products must be stored over long periods of time and transported great distances, and that they do not keep well unless highly milled. It seems best for the American people to continue to consume flour which has good keeping qualities even though poor in vitamin B, and to make up for this deficiency by eating other foods rich in this factor.

Vitamin B is readily soluble in water. It is relatively resistant to heat and is destroyed only by prolonged cooking such as occurs in canning. It should be borne in mind, however, that in the boiling of vegetables a large part of this vitamin, because of its ready solubility, is taken up by the water and may in that way be lost.

Beriberi and related disorders will be discussed in the chapter on Deficiency Diseases.

Vitamin C.—Lack of vitamin C not only produces scurvy, but it leads also to many related atypical states of ill health. In the guinea-pig a diet of bread or grain alone will produce loss of weight, hemorrhage in the skin and joints, soreness of the joints, separation of the epiphyses and disease of the gums with loss of teeth. The addition of a little cabbage or other fresh vegetable containing vitamin C will cause prompt subsidence of these symptoms.

The scurvy which occurred on the ancient sailing vessels is today a rarity. Numerous writers, however, have described atypical forms of scurvy which occur among infants and in adults who live on diets poor in vitamin C. An adequate supply of this vitamin is essential to the proper development of the teeth. Its deficiency in the food of the mother will lead to malformations and early decay of the young animal's teeth.

Vitamin C is contained in abundance in the juice of the lime, orange and lemon, although the last two are about four times as rich as the first. Lemon juice has been treated and preserved in the shape of lozenges in such a manner as to retain its antiscorbutic properties. The tomato also is especially rich in this factor, and in children especially has proved an excellent antiscorbutic. An important fact in this connection is that canned tomatoes appear to be fully as effective as the fresh fruit. Hess states that strained canned tomato can be given with impunity to infants, two tablespoonfuls being the dose for babies of 3 months. He also places considerable value on carrots and calls attention to the fact that their antiscorbutic property is dependent somewhat on their freshness. Lettuce, spinach and cabbage are of value as are also apples, strawberries, raspberries and cloudberries. Milk and eggs are variable as regards their richness in this vitamin.

Vitamin C is particularly sensitive to heat if exposed at the same time to the oxygen of the atmosphere. This destruction is greater when the food is cooked long than when it is kept at a relatively high temperature for a short period of time; thus we would expect the fireless cooker to be particularly destructive. The same applies to canning, but an exception, as stated, must be made of the tomato, perhaps because of its natural acidity. Recent experiments would indicate that this destructive action of heat on vitamin C is more properly attributable to oxidation. If protected from air during the process of cooking or canning, a food will retain its vitamin C in much greater potency. In milk vitamin C is particularly sensitive to continued heat plus oxidation. It is said that unsweetened, condensed milk loses most of its vitamin, but that the sweetened variety retains an appreciable quantity. Dried milk properly made by the Spray process also retains an appreciable amount of its antiscorbutic properties. It should be repeated that the food of the cow determines the vitamin richness of her milk.

This subject is discussed at greater length in the chapter on Scurvy.

Vitamin D.—Cod liver oil contains a substance which will prevent rickets or, if the disease is established, will stay its progress. This substance has been called vitamin D.

Rickets is a disease of metabolism which is accompanied by a disturbance of the salt equilibrium of the blood and of failure of the normal calcium deposition in the bone. McCollum and his coworkers have shown that rickets often accompanies a diet which contains an excess of calcium with suboptimal amounts of phosphorus or, on the other hand, one which contains too much phosphorus and an insufficient amount of calcium. He emphasizes the great importance to the animal of a diet which provides these two elements not only in sufficient amounts, but also in the proper ratio.

This question of the relation of diet to rickets is not difficult to settle when dealing with experimental animals; for, taking the rat as an example, a diet which presents certain faults in respect to its salt content is a potent cause of the disease. With man, however, the question is not so simple. Undoubtedly this disease in children, particularly in older children, is in some way related to faulty diet, but no single fault except a deficiency in vitamin D is common to the diet of all rachitic children. It has been suggested that the faulty diets observed in rachitic children are so constituted as to be predisposing rather than actually causative.

To turn from causation to prevention, it is evident that there are two factors, either of which will prevent or halt the development of rickets. One of these is sunlight, a highly potent factor; the other is this unknown substance which is contained in cod liver oil and to which we apply the term vitamin D. Both are factors highly effective whether acting alone or together. The manner in which these two factors act is uncertain. Park believes that they have a stimulating or regulatory influence on bone metabolism. He suggests that this disease offers excellent evidence of the dependence of the human body on the energy of the sun's rays, whether direct as ordinary sunlight or indirect in the form of equivalent energy stored in the food.

Attempts have been made to identify vitamin D with the fat-soluble vitamin A; but since cod liver oil, after its contained vitamin A has been destroyed by oxidation, still exhibits antirachitic powers and since coconut oil, which does not contain vitamin A, shows definite antirachitic properties, it seems fair to conclude, as McCollum[43] has done, that these two vitamins are distinct, and that antirachitic vitamin D has an identity of its own.

This vitamin is present in abundance in cod liver oil and in other fish oils. It is also present, but in smaller amounts, in butter fat, and coconut oil. It is missing from vegetable fats. Dubin and Funk[44] have prepared a concentrate of cod liver oil which carries in highly potent form both the antiophthalmic and the antirachitic factors. Their crude concentrate is two thousand times more active than the fish oil, which concentration may be carried to an even higher degree. Compressed tablets of potent concentrated vitamin D have been placed on the market.

Rickets and its relation to vitamin D will be more fully discussed in the chapter on Deficiency Diseases.

Vitamin E.—Evans and Bishop[40] have shown that when rats are reared on a basic ration consisting of casein, cornstarch, lard, butter fat, yeast and an appropriate salt mixture, they attain maturity in a normal manner but fail to reproduce. The sexual cycle in these animals is normal, and they conceive in an apparently normal manner; but, after a time, gestation ceases and the placenta and fetus are absorbed. It would appear that the early steps of reproduction proceed normally, and that the trouble lies chiefly if not solely in the placenta. Evans and Bishop believe that there is missing from the diet some substance essential to reproduction, and they provisionally designated this missing factor substance X; it is now called vitamin E. They have shown that this substance is distinct from all of the hitherto described vitamins; for this anomaly of reproduction cannot be prevented by butter fat (vitamin A), by yeast (vitamin B), by fresh orange juice (vitamin C) or by cod liver oil (vitamin D). It can be prevented, however, by the addition to the diet of lettuce leaves, cereals, fresh meat (cheek muscle) or egg yolk. Any of these foods will promptly restore fertility. Thus it would appear, as suggested by these authors, that certain natural foods, notably those just mentioned, contain a specific substance which is essential to reproduction.

The manner in which this vitamin acts and the circumstances which influence its action have been the subject of interesting experiments. For instance, McCollum[46a] and his co-workers have found that vitamin E aids in the assimilation of iron and that lack of it causes a "crisis in iron assimilation" which in pregnant rats leads to the death of the fetus. It is interesting, too, that this action is apparently influenced by associate factors. Evans and Burr[46b] have found that wheat germ, which is invariably rich in vitamin E, can be robbed of its curative action when it is mixed with large amounts of certain fats. For further information concerning vitamin E, the reader is referred to the section on Diet and Reproduction.

Clinical Aspects.—The clinical aspects of vitamin deficiency will be discussed in the chapter on Deficiency Diseases. It should be emphasized, however, that the interest which vitamins hold for the physician is not alone in their relation to certain well defined diseases such as scurvy, beriberi and rickets, but rather in the fact that chronic vitamin deficiency produces numerous vague, borderline states of ill health which often puzzle the physician and disable the patient. These last are of far greater importance to the physician of today than the more clearly defined deficiency diseases.

For a complete review of this subject, the reader is referred to the writings of McCollum,[18] of Sherman,[45] of Sherman and Smith[36] and of Funk.[46]

TABLE 12.—*Distribution of Vitamins in Investigated Food Materials** (*Sherman and Smith, and Others*)

Source	A	B	C	D	E
Grain products:					
Barley, whole	p	pp			
Bread, white (water)	?	p			
Bread, white (milk)	p	p	?		
Bread, whole wheat (milk)	pp	pp	?		
Bread, whole wheat (water)	p	pp	?		
Corn (maize), white	..	pp			
Corn (maize), yellow	p	pp			
Cottonseed meal	p	pp	†		
Flour, white	..	p			
Grains, sprouted	p	pp?	pp		
Brussells sprouts					
Malt, green	p	pp?	pp		
Millet	pp	pp	†		
Oats	p	pp			
Rice, polished					
Rice, whole grain	p	pp			
Rye, whole	p	pp			
Wheat, embryo	pp	pp?			
endosperm	..	p			
middlings, commercial	*	ppp			
bran	p	pp?			
whole	p	pp			
Cereals	......	......	....	......	p
Sugars and Starches:					
Glucose					
Honey	..	p			
Starch					
Sugar					
Fats and Oils:					
Beef fat	p				
Butter	ppp				
Coconut oil					
Codliver oil	ppp	?	......	ppp	
Corn oil	p?				
Cottonseed oil	p?				
Horse fat	p				
Lard	p?				
Linseed oil					
Margarine, nut					
oleo	p				
Mutton fat	p				

* Vitamins A, B and C are taken from Sherman and Smith: The Vitamins. Vitamins D and E are taken from various sources.

p indicates that the food contains the vitamin; pp, that the food is a good source of the vitamin; ppp, that the food is an excellent source of the vitamin; —, that the food contains no appreciable amount of the vitamin; ? doubt as to presence or relative amount; * that evidence is lacking or appears insufficient. Each † in the table may be taken as a suggestion for further research.

TABLE 12.—*Distribution of Vitamins in Investigated Food Materials** (*Sherman and Smith, and Others*) (*Continued*)

Source	A	B	C	D	E
Olive oil	p				
Oleo oil	pp	†	†		
Orange peel oil	p				
Palm oil					
Peanut oil	pp				
Pig kidney fat	pp	†			
Whale oil					
Meats and Fish:					
Beef liver	..	..	......	..	p
Brains	p	pp	p?		
Cheek muscle	..	..	......	..	p
Fish, lean	..	p	†		
fat	p	p	†		
Heart	p	p	p?		
Kidney	pp	pp	p?		
Liver	pp	pp	p		
Meat (muscle)	to p	p?	p?		
Meat, canned	..	slight			
Roe, fish	p	pp	p?		
Sweetbreads	p	p	†		
Fruits:					
Apples	p	p	p		
Bananas	p?	p?	p		
Cloudberries	†	†	ppp		
Cloudberries, canned	†	†	ppp		
Cocum (dried)	†	†	p		
Grape juice	†	p	p		
Grapefruit	†	pp	pp		
Lemon juice	†	pp	ppp		
juice, dried	†	pp	ppp		
Limes	†	p	p		
Mango	†	†	p		
Mulberries	†	†	p		
Orange juice	p	pp	ppp		
peel	p	p	pp		
Pears	†	p	†		
Prunes	†	p			
Raspberries	†	†	ppp		
Raspberries, canned	†	†	ppp		
Tamarind, dried	†	†	p		
Tomatoes, raw	pp	ppp	ppp		
canned	pp	ppp	ppp		
dried	pp	ppp	pp		
Vegetables:					
Alfalfa	ppp	ppp	†	p	
Beans, kidney	†	ppp	†		
Beans, navy	†	ppp			
Beans, soy	p	ppp			
Beans, sprouted	†	†	pp		

TABLE 12.—*Distribution of Vitamins in Investigated Food Materials** (*Sherman and Smith, and Others*) (*Continued*)

Source	A	B	C	D	E
Beans, string, fresh	pp	pp	pp		
Beets	†	p	†		
Cabbage, fresh raw	p	ppp	ppp		
cooked	p	pp	pp		
dried	p	pp	p		
green	pp	pp	ppp		
Carrots, fresh raw	pp	pp	pp	p	
Carrots, cooked	pp	p	p		
Cauliflower	p	pp	p		
Celery	†	p	†		
Cress	†	†	p		
Chard	pp	p	†		
Cucumber	†	p	†		
Dandelion greens	pp	pp	p		
Dasheens	?	p	p		
Eggplant, dried	†	pp	†		
Endive	p	†	p		
Legumes, sprouted	†	†	pp		
Lettuce	pp	pp	ppp	. .	p
Onions	†	pp	pp		
Parsnips	?	pp	†		
Peas	pp	pp	p?		
Peas, sprouted	†	†	pp		
Potatoes, sweet	pp	p	†		
Potatoes, white, raw	p	pp	pp		
Potatoes, white, boiled 15 minutes	†	pp	pp		
Potatoes, white boiled 1 hour	†	pp	p		
Potatoes, white, baked	†	pp	p		
Radish	†	p	†		
Rhubarb	†	†	p		
Rutabaga	?	pp	ppp?		
Sauerkraut	†	†	?		
Spinach, fresh	ppp	ppp	†		
Spinach, dried	ppp	pp	†		
Squash, hubbard	pp	†	†		
Swede	†	pp	ppp?		
Turnips	?	pp	†		
Nuts:					
Almonds	p	p	†		
Brazil nuts	?	pp	†		
Chestnut	†	p	†		
Coconut	p	pp	†		
Coconut press cake	p	pp	†		
Filberts	†	pp	†		
Hickory nuts	†	pp	†		
Peanuts	p	pp	†		
Pecans	†	p	†		
Pine nuts	p	p	†		

TABLE 12.—*Distribution of Vitamins in Investigated Food Materials** (*Sherman and Smith, and Others*) (*Continued*)

Source	A	B	C	D	E
Walnuts, black	†	pp	†		
Walnuts, English	†	pp	†		
Milk:					
Milk	ppp	pp	p variable.		
Milk, condensed	ppp	pp	p variable.		
Milk, evaporated	ppp	pp	?		
Milk, dried, whole	ppp	pp	p variable.		
Milk, dried, skim	p	pp	p variable.		
Skimmed milk	p	pp	p variable.		
Dairy products:					
Butter	ppp				
Buttermilk	p	pp	p variable.		
Cream	ppp	pp	p variable.		
Cheese	pp	†	†		
Cottage cheese	p	†	†		
Eggs:					
Eggs	pp	p	p?		
Egg white	†	†	†		
Egg yolk	ppp	p	†	p	p
Yeast:					
Yeast	..	ppp			
Yeast extract	..	ppp			

MINERAL REQUIREMENT

Every element which finds place in the structure of the cell is essential to life. No distinctions of relative importance can be drawn, for, since all components of the cell are essential, all are therefore of equal importance. The application of this fact to the inorganic or so-called mineral components of the food should be emphasized.

When food is burned in the air, its mineral components appear in the ash as inorganic salts, and an analysis of this ash will give accurate information as to the total mineral content of the food. The information thus obtained, however, may in certain respects be misleading, for it does not necessarily follow that all of a certain element found in the ash existed previously in an available form; a part, for instance, may have been firmly bound in some combination which the organism could not split. As a rule, however, the analysis of the ash will permit a fairly accurate statement of the mineral elements offered to metabolism by the food.

The assumption is current that a diet which in other respects is satisfactory will furnish a sufficient amount of the necessary mineral elements. This is by no means true. Studies of the average American dietary have shown that the content of the food in mineral elements often falls far below the calculated optimum and sometimes below the minimum. A striking example of this is the failure of many dietaries to furnish sufficient calcium.

The mineral elements of the food have three chief functions: 1. They contribute overwhelmingly to the supporting framework of the body, the bony structure. 2. They take part in the formation of many organic compounds, such as nucleoproteins and phosphatids and thus form an integral part of the cell structure; every cell contains mineral elements. 3. They circulate in the body fluids in various combinations; as inorganic salts, as dissociated ions, and in more or less loosely bound organic combinations. In this way the mineral salts of the plasma serve to maintain the osmotic tension necessary to life, as well as play a determining rôle in neutrality regulation.* One of the most remarkable facts of physiology is the unvarying constancy with which the mineral content of animal plasma has remained unchanged through all the ages.

Do the native foods contain mineral elements in correct proportions and in sufficient amounts? As a rule, yes; for the lower animals, whether herbivorous or carniverous, secure all of the mineral salts they need from their food. Two exceptions to this statement, however, should be noted: plants are often deficient in sodium; and milk is faulty in respect to its iron content. Civilized man, however, in his efforts to secure from his food all needed mineral elements is hampered by certain factors which do not influence the lower animals: 1. The peel of fruit and the hull of cereal grains are rich in mineral elements, but in preparing such foods for the table we often rob them of these important substances, particularly of iron, calcium and phosphorus. 2. In cooking, an appreciable amount of mineral matter goes into solution and is thrown away (the value of "Pot-licker!"), but fortunately this loss is limited by the fact that many of the inorganic salts are bound to albuminous bodies which coagulate on boiling and thus retain their mineral content. 3. The availability of a mineral element is sometimes limited by the firmness with which it is held in union with some organic component of the food. It may for example be held in chemical union with cellulose, and until this indigestible substance is split by intestinal bacteria, or otherwise, it cannot be taken up by the body. No doubt an appreciable amount of mineral salts are in this way lost to the organism. 4. In this connection, too, it should be borne in mind that the modification of cows milk by dilution in order to reduce the protein percentage to that of human milk incidentally may reduce the calcium content of the infant's food to a dangerous degree.

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* Neutrality regulation was discussed in an earlier chapter.

Utilization of Minerals.—In what form are the mineral elements absorbed by the intestine and utilized by the cell? Is it (*a*) in organic combination, (*b*) as inorganic salt, or (*c*) as dissociated ion? This debated question has been the subject of a great deal of experimental work, the chief interest of which has centered around the element iron. For the construction of the hemoglobin molecule, can the body utilize a simple inorganic (medicinal) salt or must receive its iron in organic form.[2] The fact that iron is eliminated largely through the bowel, led at first to many errors in the interpretation of experimental data. Because large quantities were found in the feces it was thought that the element, when given in inorganic form, had passed through unabsorbed; whereas in fact it was absorbed and the inorganic salts found in the feces represented in large measure the end-products of metabolism. Some of the earlier experimental work done in an effort to solve this question was fallacious, because in the feeding of "organic" iron, as in egg yolk, other substances, notably vitamins, were incidentally administered and thus permitted to obscure the results. A review of the more recent work seems worth while.

Investigators have studied particularly the type of anemia known as chlorosis, because it has been evident that the administration of inorganic iron in this disease is of distinct benefit. To explain this benefit, the believers in organic iron put forth the theory that the inorganic element "fixed" the hydrogen sulphide of the bowel and thus gave the organic iron of the food a chance for absorption. The fallacy of this has been shown in the fact that the small intestine, from which practically all absorption takes place, contains little or no hydrogen sulphide, and also in the work of Stockman,[47] who demonstrated that pills of iron sulphide, which obviously are saturated with sulphur, are just as efficacious in chlorosis as other forms of iron. This author showed, too, that inorganic iron was effective when given intravenously—all of which disproves the hydrogen sulphide theory.

The utilization of iron has been studied by microchemical methods. Investigators have been able to demonstrate the presence of this element in the wall of the intestine as well as in the mesenteric lymph nodes; they have thus proved that iron is absorbed in inorganic form.

Sherman quotes the work of Häuserman in Bunge's laboratory, which led to the conclusion that inorganic iron is absorbed as such, but that it is used little if at all for the production of hemoglobin. The same author quotes the earlier writings of Abderhalden,[48] in which he expressed the opinion, based on extensive animal experiment, that inorganic iron is absorbed and stored as such and is of use in blood building, but that its influence is through the stimulation of the blood making organs rather than by actual participation in the construction of the hemoglobin molecule. This was the generally adopted opinion of a few years ago. In his more recent writings, quoted below, however, Abderhalden expresses a somewhat different view.

A diametrically opposed opinion was reached by Tartakowsky[49] and by Schmidt,[50] both of whom fed animals a diet of rice and milk, which is poor in iron, and gave control animals on the same diet iron in inorganic form. Both of these workers conclude that inorganic iron can be utilized directly by the organism for the production of hemoglobin.

More recently, Williamson and Ets,[51] on the basis of carefully planned animal experiments, concluded that while inorganic iron is promptly absorbed and stored in the body, it is not used for the building of hemoglobin. The evidence which they present appears at first glance to be final, and in some quarters it has been so accepted. The fallacy of their conclusion, however, is seen in the work quoted below.

Whipple[52] and his associates have shown that inorganic iron is of no immediate value in the treatment of persons with anemia of brief duration, because the body first utilizes only the precursors of hemoglobin which are stored in the liver ready for use. After these more complex "building stones" have been exhausted, as occurs in long continued anemia, the supply of inorganic iron is drawn on and is used for the construction of hemoglobin. One would conclude from this work that had the anemias studied by Williamson been of longer duration, the conclusion would have been different. On the basis of animal experiment with long continued anemias, Whipple[53] writes:

> I believe that given a shortage of iron in the body the organism is perfectly capable of making use of almost any kind of iron presented to it, chloride, carbonate, acetate, etc., as well as the more complicated so-called organic iron. Whether the stores held in reserve in the body may be called organic or inorganic iron I am not certain but when this storehouse is exhausted after long continued anemia the body is perfectly capable of using the simplest form of inorganic or the more complex organic iron, depending upon which form is available.

The many contradictions in animal experiments are understandable when we recall that iron is merely one of the several building stones by which the hemoglobin molecule is constructed. If any essential substance, whether mineral element, amino-acid or other type of building stone is missing, no matter how abundant the supply of iron, there can be no construction of hemoglobin. We can no more build hemoglobin with iron alone than we can make thyroxin with iodine alone. The multiplicity of factors which influence iron utilization is seen, too, in the work of McCollum[46a] and his co-workers, who found that lack of vitamin E produced in rats a "crisis in iron assimilation" of far-reaching influence (see vitamin E). However, when iron is needed, the body can utilize it in any form in which it is presented.

A similar problem is presented by phosphorus. Is the body able to synthesize nucleoproteins, phosphoproteins and phosphatids from inorganic phosphates, or must it receive its phosphorus already prepared in organic combination? Here, too, animal experiment has been contradictory. To some workers organic phosphorus has proved more efficacious; to others, inorganic phosphorus has appeared to meet all metabolic needs. It appears that Marshall[54] has correctly summarized the phosphorus problem when he says that for the purposes of the animal organism, phosphorus is just as suitable in inorganic form as in organic combination.

The same question has been raised concerning calcium, but it is evident today that this element, taken in inorganic form (lime water), can be effectively utilized by the body to supplement the calcium supply of the food. Likewise, it has been shown that iodine when administered in inorganic form, as for goiter, is effective.

To summarize the question of the availability of inorganic salts for nutritive purposes: It does not seem unreasonable to assume that if the body can utilize several of the necessary elements in inorganic form, it can utilize all in the same form; that if calcium, sodium and iodin can fulfill their usefulness in the animal economy when taken in inorganic form, then iron, phosphorus and the other mineral elements can accomplish similar functions in the same form. Abderhalden, in his later writings, is evidently of this opinion, for he states unequivocally that every mineral compound, whether organic or inorganic, must be split and the mineral element set free before it can be utilized. He states that in most instances the mineral is absorbed either as the salt or as the free ion, and that it is taken up by the cell, not in organic combination, but as the ion. He says of iron:[55]

> Since it has now been definitely determined that the animal organism as a general rule does not take up directly the organic-inorganic compounds, but rather prepares the building stones in the gastro-intestinal tract, we can no longer doubt that iron presented in the inorganic form can be used by the tissues for synthesis.

And in another place, he writes:[56]

> "We can say at the present time only this,—that manifestly iron, calcium, and also phosphoric acid in inorganic form suffice for many and perhaps for all functions, in fact it is in form that they must be available to the cells in order to satisfy their several needs."

The answer to this entire problem is perhaps best summarized by by McCollum and Simmonds[57] in the statement that successful experiments involving growth have repeatedly demonstrated that the animal organism is capable of utilizing inorganic compounds of sodium, potassium, calcium, magnesium, chlorine, iodine, phosphorus and iron, when no other sources of these elements are provided.

The several mineral elements are not interchangeable. Each has its own place in metabolism, and substitution is not possible. Even closely related elements, such as sodium and potassium, exerts each its own individual influence. Some are antagonistic toward others, some are synergistic. It has been shown, for instance, that the ingestion of large quantities of potassium, as in a vegetable diet, causes depletion of the body's sodium reserves, and thus occasions, as is experienced by herbivora, the urgent need for additional sodium in the form of common salt. Other closely related elements, such as calcium and magnesium, also seem to exert mutually antagonistic effects. Meltzer and Auer,[58] in studying the general inhibitory influence of magnesium, demonstrated that this influence can be counteracted by the administration of calcium. A similar antagonism between these two elements has been reported by other workers. It has been found that the administration of magnesium exerts such an unfavorable influence on calcium metabolism that by this means a negative calcium balance can be produced.

A more beneficient effect is exerted by calcium. This is particularly noteworthy in the synergistic influence which this element exhibits toward iron; for with an abundant intake of calcium, the organism can maintain equilibrium on an appreciably smaller supply of iron. Indeed, according to the authors just quoted, the beneficent influence of calcium is manifold: it is able to correct inorganic imbalance of either direction: It nullifies the deleterious influence of sodium, potassium or magnesium, whether this influence be in the direction of increased or of decreased irritability, and thus "is capable of reestablishing normal equilibrium." When we come to know more of the influences of the mineral elements on the animal organism, we shall have still greater respect for them.

Daily Requirement.—Analysis of the ash of animal tissues reveals the presence of the following elements: iron, sodium, potassium, magnesium, calcium, phosphorus, sulphur, chlorine, iodine, fluorine, lithium, barium, manganese and silicon. Other elements, such as arsenic and bromine, are probably also present in extremely small amounts. Some of these are needed by the animal organism in amounts so small that a sufficient supply is assured by almost any diet. Others are needed in more appreciable amounts, some in such large amounts that the diet often fails to meet this requirement. In this last group are included iron, calcium and phosphorus; they are entitled to special consideration.

Iron.—The iron requirement of the human organism varies somewhat according to circumstances. The daily excretion of this element by the professional fasters, Cetti and Breithaupt, was 0.00073 and 0.00077 Gm. a day each when fasting. Sherman reports three experiments in which, on a diet containing from 0.0057 to 0.0071 Gm. of iron, the subjects metabolized daily 0.0055, 0.0087 and 0.0126 Gm. This author concludes that the average adult requires from 0.006 to 0.016 Gm. of iron a day. This, however, does not take into consideration all contingencies. Allusion has already been made to the influence of calcium on iron metabolism and to the fact that with an abundant supply of calcium a person can get along with a smaller amount of iron. For instance, the author just quoted has shown that certain experimental animals will maintain iron equilibrium on a bread and milk diet which contains an abundance of calcium, whereas on a bread and egg-white diet of equal caloric value and even greater iron content, but containing much less calcium, they will show a definite loss of iron. To meet every hazard, it would appear that the food of the average adult should contain daily 15 mg. of iron.

Growing children and nursing mothers require relatively more iron than men. Women need more iron in order to meet the demands of menstruation, pregnancy and lactation; children need it as a building material for hemoglobin and the other cell components which are increased so rapidly during the period of growth. Milk, the food of the infant, is poor in iron, but fortunately the young animal before birth receives from the mother an abundant supply of this element which is stored and subsequently used during the nursing period. The young rabbit at birth contains 139 mg. of iron per 100 Gm. of body weight, of which 42 mg. is in the form of hemoglobin, whereas three weeks later the corresponding figures are 43 Gm. and 8 mg. The large body surface and lack of adequate covering at birth would explain the need at this time for this relatively greater amount of hemoglobin. For man, the percentage of iron at birth is about three times as high as at maturity.

Regarding the actual iron content of the average diet, the studies by Sherman on 150 American dietaries would indicate that these furnished about from 14 to 20 mg. of iron a day; just enough to cover the calculated needs with little or no margin. Evidently, then, we cannot afford to disregard the iron content of the food.

Lean meats are rich in iron because of the hemoglobin contained therein, but there is very little of this element in fat meats. Fresh lean beef contains about 0.00375 per cent of iron, which means that it furnishes from 15 to 16 mg. per hundred grams of protein.

Eggs contain a liberal amount of iron in a readily assimilable form. This is evident from the fact that the only source of iron for the building of hemoglobin by the embryo chick is that contained in the egg. The edible portion of hens' eggs contain about 0.00303 per cent of this element.

Milk contains iron in a readily assimilable form, and, although the percentage is low, it is nevertheless present in appreciable amounts and is of importance. The conclusion was reached by Bunge, because of the likelihood of digestive disorders and for other reasons, that the absorption of iron from the intestinal tract of the suckling is undependable. Abderhalden points out, however, that the rapidly growing suckling normally increases at a material rate the total iron content of the body, and that this increase can come only from the iron received in the milk. Therefore, while we stress the relatively low iron content of milk, we must not lose sight of the fact that even this small amount is of great value to the growing organism. Fresh cow's milk contains from 0.0002 to 0.0003 per cent of iron. One of the dangers of artificial feeding is the reduction by dilution of this iron content of the milk.

The abundant iron contained in the hull of cereal grains has been mentioned, but a great deal of this is discarded in the milling of flour. It seems advisable, however, because of its better keeping qualities to continue to eat white flour and to secure from other foods the valuable substances which are lost with the outer layers of the wheat. Vegetables and fruits as a rule are rich in iron. Comment has been made repeatedly that herbivorous animals are less likely to have anemia than carnivorous animals, and the explanation is offered that the former are always able to secure an abundant amount of readily assimilable iron from the plants they eat. Spinach, cabbage, string beans, carrots, dried beans and dried prunes are especially valuable in this respect.

Fatty foods, such as bacon, fat pork, lard, and butter are poor in iron, and if these are permitted to contribute materially toward a person's total caloric intake, the iron content of his diet is likely to be low. The same can be said of sugars and starches—all of which furnishes another reason, among many, as to why vegetables and fruits should always have a prominent place in the dietary.

The following table prepared by Sherman gives the iron content of certain of the commoner foods: (*a*) in milligrams per hundred Gm. of edible material, (*b*) in milligrams per hundred grams of protein, and (*c*) in milligrams per three thousand calories.

Calcium.—The mineral content of the American diet is more likely to be faulty in respect to calcium than to any other element. Sherman

TABLE 13.—Iron in Typical Materials* (Sherman)

Food	Iron per 100 Grams Fresh Substance	Iron per 100 Grams Protein	Iron per 3,000 Calories
	Milligrams	Milligrams	Milligrams
Beef, all lean	3.0†	13	80*
Beefsteak, medium fat	2.0†	13	43*
Eggs	3.0	22	57
Egg yolk	8.6	53	69
Milk, whole	0.24	7	10
Milk, skimmed	0.25	7	20
Cheese	1.3	5	9
Oatmeal	3.8	22	26
Rice, polished	0.9	11	7
White flour	1.0	7	7
Wheat, entire grain	5.0	37	42
Beans, dried	7.0	40	60
Beans, string, fresh	1.1	48	80
Beets	0.6	38	39
Cabbage	1.1	69	104
Carrots	0.6	55	40
Corn, sweet	0.8	26	23
Peas, dried	5.7	23	46
Potatoes	1.3	55	42
Spinach	3.6	135	450
Turnips	0.5	39	38
Apples	0.3	78	15
Bananas	0.6	47	18
Oranges	0.2	25	12
Prunes, dried	3.0	143	30
Almonds	3.9	19	18
Peanuts	2.0	8	11
Walnuts	2.1	11	9

* This table is taken from Sherman, H. C.: Chemistry of Food Nutrition, Ed. 2, 1923, p. 270.

† Figures for meats can be only rough approximations because of variations in fatness, as well as differences between different cuts. Forbes and Swift report that organs contain more iron than muscle meats, while pork and lamb contain much less than beef.

has shown that at best an intake of 0.45 Gm. of calcium a day is essential. This corresponds to a protein intake of about 50 Gm. This author quotes the work of Nelson and Williams showing that healthy men on a restricted diet excrete from 0.68 to 1.02 Gm. of this element a day. To allow a sufficient margin of safety, we should assume that the average man, in order to preserve equilibrium, must have an intake of at least 0.75 Gm. of calcium daily. Many dietaries fall below this figure. The need for calcium is especially great in women and children. Pregnant and lactating women must receive an abundance of this element in order to meet the demands of the fetus for bone building and of the suckling for milk rich in calcium. If the mother is not supplied with a sufficient amount of food calcium, in order to meet these requirements, she will draw on her own bones and other structures. This no doubt explains the dental caries and bone disturbances often noted during and just after pregnancy. It is well to remember in this connection that great inroads can be made on the bony structures without immediately obvious effects; marked bone changes may take place before weakening progresses to the point of recognition.

The need of the infant and growing child for calcium is great. It has been estimated that even the abundant supply obtained from the milk is only sufficient to meet the suckling's needs without providing any material margin of safety or providing for calcium storage. Therefore, on weaning the child care should be taken that it continues to receive food rich in this element. The growing child must have at least 0.1 Gm. of calcium a day beyond that needed for maintenance. Under ideal conditions, boys are said to consume from three to four times as much calcium per kilogram of body weight as is required for men.

TABLE 14.—*Approximate Amounts of Calcium in Food Materials* (*Sherman*)

Food	Calcium per 100 Gm. Edible Substance, Grams	Calcium per 100 Gm. Protein, Grams	Calcium per 3,000 Calories, Grams
Beef, all lean	0.007	0.03	0.18
Eggs	0.067	0.5	1.35
Egg yolk	0.137	0.9	1.1
Milk	0.120	3.7	5.2
Cheese	0.931	3.5	6.4
Wheat, entire grain	0.045	0.33	0.40
White flour	0.020	0.18	0.19
Rice, polished	0.009	0.06	0.04
Oatmeal	0.069	0.4	0.5
Beans, dried	0.160	0.7	1.4
Beets	0.029	1.9	1.9
Cabbage	0.045	2.8	4.3
Carrots	0.056	5.1	3.7
Potatoes	0.014	0.6	0.5
Turnips	0.064	5.0	4.8
Apples	0.007	1.9	0.36
Bananas	0.009	0.7	0.27
Oranges	0.045	5.7	2.6
Prunes, dried	0.054	2.6	0.5
Almonds	0.239	1.2	1.1
Peanuts	0.071	0.3	0.4
Walnuts	0.089	0.5	0.4

Because bone is an apparently stable structure it must not be assumed that calcium metabolism, even in the adult approaches a standstill. These structures are subject to constant change; disuse or too much use results in characteristic alteration of the bones involved. This is not the place to discuss the nature of rickets or of osteomalacia, but it can be said that in each of these, whatever the ultimate cause, disturbed calcium metabolism plays a part. McCollum has shown that rickets can be produced by a disturbance of the calcium-phosphorus ratio; it seems probable also that osteomalacia is related in some way to faulty calcium supply.

The rôle of calcium in animal metabolism is not limited to the building of bone. It is essential to the normal action of the heart and to the coagulation of the blood; it has important iron-sparing qualities; it will correct the disturbances of inorganic imbalance in either direction—all of which illustrates its far-reaching influence.

Meat and milled cereal products are poor in calcium. Fruits and vegetables are relatively rich. Milk, above all other foods, supplies an abundant amount of calcium. This is another reason why milk is not only essential for infants and growing children, but is valuable as a food for adults as well. It will supply more calcium even than the same amount of clear lime water. To insure a satisfactory calcium intake, the diet should contain a liberal quantity of milk.

Phosphorus.—In estimating the need for phosphorus it is difficult to take the rate of excretion as a criterion of intake, for this element is excreted in varying proportions in both feces and urine. Sherman has found that an adult weighing 70 kilograms requires daily an intake of 0.96 Gm. of phosphorus for the maintenance of equilibrium. Add a 50 per cent "factor of safety," and we have approximately 1.5 Gm. of phosphorus as the lowest intake which is compatible with safety for the adult. For the growing child who must store phosphorus, a much larger amount proportionately, perhaps two or three times as much, is obviously desirable. In the studies by Sherman of 150 typical American dietaries, it was shown that a diet which is adequate in respect to caloric and protein values is often inadequate as regards its phosphorus content.

Phosphorus forms an integral part of the nuclear structure of every cell, and thus is intimately concerned in all cell multiplication. It contributes largely to the bony structures, is an essential constituent of the plasma and other fluids, and is found in organic union with proteins, fats and carbohydrates. It aids in the work of the various glands and can be found in their products, particularly in milk and in the sexual elements. Phosphorus is widely distributed in the animal body; it is perhaps the most widely distributed of all the inorganic elements. It occurs in the body in four forms: (*a*) as inorganic phosphates; (*b*) in combination with fat—phosphatids, of which lecithin is the best example; (*c*) in combination with proteins, nucleoproteins, lecithoproteins and phosphoproteins, and (*d*) in union with carbohydrates. The starch molecule is said to contain minute quantities of this element.

The phosphorus obtained from the food comes to the animal organism in all of the combinations noted above. Is any one of these compounds more useful to the body than another? Are nucleoproteins, for instance, more readily utilized than phosphatids or the phosphates? This has been a moot question. An attempt was made to answer it, at least tentatively, at the beginning of this chapter in the general discussion on the relative nutritive value of inorganic or organic compounds. It has been shown[59] that ducks will lay just as many eggs when fed on a diet free from phosphorus, supplemented by inorganic phosphates, as when fed on food rich in organic phosphorus. All phosphorus compounds, whether organic or inorganic, must be broken down and the phosphorus set free before this element can be used by

Table 15.—*Approximate Amounts of Phosphorus in Food Materials* (*Sherman*)

Food	Phosphorus per 100 Gm. Edible Substance, Grams	Phosphorus per 100 Gm. Protein, Grams	Phosphorus per 3,000 Calories, Grams
Beef, all lean	0.218	0.96	5.2
Eggs	0.180	1.35	3.66
Egg yolk	0.524	2.73	3.54
Milk	0.093	2.82	4.02
Cheese	0.683	2.58	4.68
Wheat, entire grain	0.423	3.25	3.54
White flour	0.092	0.81	0.78
Rice, polished	0.096	1.19	0.81
Oatmeal	0.392	2.36	2.97
Beans, dried	0.471	2.20	4.11
Beets	0.039	2.42	2.52
Carrots	0.046	4.17	3.03
Potatoes	0.058	2.60	2.07
Turnips	0.046	3.55	3.51
Apples	0.012	3.15	0.60
Bananas	0.031	2.35	0.93
Oranges	0.021	2.58	1.20
Prunes, dried	0.105	5.00	1.05
Almonds	0.465	2.25	2.16
Peanuts	0.399	1.55	2.19
Walnuts	0.357	1.96	1.53

the body cells. This usually takes place in the intestine. There seems to be no proof that any organic phosphorus compound is of more nutritive value than the inorganic phosphates.[60]

The fact that two-thirds of the phosphorus of the body is found in bone does not indicate that the phosphorus metabolism is slow, for, as was said above, the metabolism of bone never ceases; and the manifold functions which phosphorus performs in other structures also call for rapid metabolic changes.

Eggs and milk are particularly rich in phosphorus. Table 15 shows the phosphorus content of the commoner foods.

Magnesium, Sodium and Potassium.—These elements are seldom lacking in the diet. A sufficient supply of magnesium is furnished by meats and plant foods. An excessive intake of this element causes a calcium loss, which accentuates at times the need for a liberal calcium intake. Potassium also is abundantly supplied by vegetables and fruits. A superabundance of this metal hastens sodium secretion, which explains why herbivora at times exhibit such an imperative need for sodium in the form of common salt. Man gets ample sodium in the salt which he adds to his food.

Chlorine and Iodine.—Chlorine appears in the body chiefly as chlorides; in large part as the sodium salt. The hydrochloric acid of the stomach is derived by the glands from the chlorides of the blood. The blood chlorides, in addition to other important functions, play an important rôle in the maintenance of osmotic pressure, and in this manner profoundly influence the water content of the tissues. Chlorides are normally excreted in large amounts in the urine, but as the intake ordinarily is considerably in excess of actual needs there is a marked falling off in the output when the supply is reduced. For instance, Benedict reports during the first day of fasting an output of 3.77 Gm. of chlorine and on the thirty-first day 0.13 Gm. The latter figure, however, should not be taken to indicate the optimum intake; it is too low. The actual daily need for chlorides expressed as the sodium salt is probably about 2 Gm. Animals will brave all sorts of dangers to reach a "salt lick;" primitive peoples have gone to war in order to secure an adequate supply of salt.

The interest of the physician in the chloride content of the food is not so much in assuring the patient a sufficient amount of this element as in providing that he does not take too much. There is a happy medium. Unquestionably moderate chloride restriction in disease, especially in nephritis, is advisable, but the weight of clinical and experimental evidence[61] would indicate that absolute restriction to the lowest possible minimum, as is sometimes advised, if continued over a

Table 16.—*The Chlorine Content of Some of the Commoner Foods* (Sherman)

Food	Chlorine
Almonds	0.037
Apples	0.005
Asparagus	0.039
Bananas	0.125
Lima, fresh	(0.009)
String, fresh, beans	0.024
Blackberries	(0.010)
Cabbage	0.024
Carrots	0.036
Cauliflower	0.050
Celery	0.156
Chestnuts	0.006
Dandelion	0.099
Dates	0.228
Grapefruit	0.005
Grapes	0.005
Lemons	0.002
Lettuce	0.074
Onions	0.021
Oranges	0.006
Peaches	0.004
Peanuts	0.056
Pears	0.011
Peas, fresh	0.024
Pecan nuts	0.050
Pineapple	0.051
Potatoes	0.038
Raspberries	
Spinach	0.074
Strawberries	0.006
Tomatoes	0.034
Watermelon	0.008

long period of time will have unfavorable and perhaps even disastrous results. This will be discussed further in the chapter on Nephritis.

Iodine is necessary to the organism in only extremely small amounts; yet if this small supply fails, trouble results. Traces of this element are found in most of the tissues, by far the larger amount being in the thyroid gland. It is an essential constituent of the thyroxin molecule;[62] if a person does not secure sufficient iodine, thyroid disease results. The simple colloid goiter of adolescence, for instance, which is encountered so often in certain regions near the Great Lakes is probably due to the fact that the water and soil—and hence the vegetables—are poor in iodine. The daily administration of small doses of iodine will prevent or cure this trouble.[63] The Swiss plan in goiter regions is to give each school child at weekly intervals a tablet containing from 5 to 10 mg. of iodine. A great many manufacturers of table salt now place on the market an "iodized salt" which can be used as a convenient source of iodine supply. The relation of iodine to goiter is considered more fully in the chapter on Deficiency Diseases. For a complete discussion of the subject the reader is referred to a recent monograph by Marine.[64]

WATER BALANCE

Water is a vitally important factor in nutrition. Measured by the urgency of demand and the promptness with which disaster follows failure of supply, it is of greater importance than the ordinary foodstuffs, and is second only to oxygen. It is the vehicle which transports to the cells the nutritive elements and carries away the waste products of metabolism; it furnishes the medium in which all intracellular chemical changes take place. It exists in the body not only as "free water" in the fluids and tissues, but also in loose combination with the colloids; in the latter state it probably acts as a solvent for the colloids and related electrons. This "water reserve" varies in the dog from 0 to 72 cc. per kilogram of body weight; its amount depends on the carbon dioxide combining power of the blood. This importance of water to the cell and hence to the entire organism is so self-evident and the need is so promptly recognized and easily met, that it requires little discussion.

Absorption of water takes place in the large and small intestines, little or none being absorbed from the stomach. It leaves the body through the kidneys, the lungs, the skin and the bowel. In health a fairly accurate balance of intake and output is maintained. As the output increases and there is danger of dehydration, the individual instinctively drinks more fluid. Conversely, when large amounts of fluid are taken, the output increases. Thus in health water balance is automatically maintained.

Table 17 gives an estimate made by Soderstrom and Du Bois[65] of water intake and output under approximately normal conditions. Attention is called to the fact that the organism receives water from three sources: (*a*) ingested fluids, (*b*) the water contained in solid foods, and (*c*) that produced in the chemical reactions of metabolism.

Solid foods all contain water, some in large amounts, and from this source alone the ordinary mixed diet may provide as much as a liter of water a day. Obviously the oxidation of organic matter such as constantly takes place in metabolism must result in the production of an appreciable amount of water—in fact, it is probable that intracellular reactions and readjustments take place in water of the cell's

TABLE 17.—*Water Balance (Soderstrom and Du Bois)*

Water Intake:	Grams	
Drinking water	300	
Water in coffee, milk, soup	580	
Water in "solid foods"	720	
H_2O from oxidation of 100 Gm. protein	41	
H_2O from oxidation of 110 Gm. fat	118	
H_2O from oxidation of 244 Gm. carbohydrate	135	
		1,894
Water Output:	Grams	
Water in urine	750	
Water in feces	300	
Water vaporized through skin and respiratory passages	700	
		1,750
Plus balance to body		144
Gain in body weight		100

TABLE 18.—*Water Content above 50 Per Cent (Rowntree)**

Food	Water, Per Cent	Average Serving, Gm.	Calories	Food	Water, Per Cent	Average Serving, Gm.	Calories
Cucumbers	95.4	50	8.92	Cod steaks, fresh	79.7	100	81.32
Lettuce	94.7	25	4.9	Smelts	79.2	100	88.9
Wax beans, canned	94.6	100	17.74	Lobster	79.2	100	83.98
Celery	94.5	50	9.48	Lima beans, canned	78.5	100	79.0
Asparagus, canned	94.4	100	18.56	Macaroni, cooked	78.4	100	91.03
Tomatoes, fresh	94.3	100	23.4	Brook trout	77.8	100	98.25
Tomatoes, canned	94.0	100	23.18	Green corn, canned	76.1	100	100.52
Brussels sprouts, canned	93.7	100	21.02	Potatoes, boiled	75.5	100	88.67
Beef juice	93.0	100	25.67	Halibut	75.4	100	124.62
Whey	93.0	100	27.39	Bananas	75.3	100	101.11
Water melon	92.0	100	29.81	Plums	74.5	100	82.0
Radishes	91.8	50	15.02	Cream, 18 per cent	74.0	100	200.75
Onions, boiled	91.2	100	41.75	Mackerel	73.4	100	142.7
Buttermilk	91.0	100	36.63	Egg, boiled	73.2	50	56.3
Strawberries	90.4	100	40.0	Rice, boiled	72.5	100	112.45
Spinach, cooked	89.8	100	22.06	Cottage cheese	72.0	50	56.3
Beet greens, cooked	89.5	100	25.80	Veal leg	71.7	100	147.24
Peaches	89.4	100	42.34	Liver	71.0	100	132.46
Pineapple	89.3	100	44.2	Sweet breads	70.9	100	191.41
Koumiss	89.3	100	53.15	Tongue	70.8	100	163.5
Beets, cooked	88.6	100	40.5	Chicken, white meat	70.3	100	158.57
Oysters, solids	88.3	100	50.2	Lamb leg, roast	67.1	100	198.81
Squash, canned	87.6	100	51.39	Pork tenderloin	66.5	100	198.39
Milk	87.0	100	71.23	Salmon, fresh	64.6	100	209.24
Oranges	86.9	100	52.7	Salmon, canned	63.5	100	208.47
Egg whites	86.2	32	17.6	Sirloin steak	61.9	100	249.54
Peas, canned	85.3	100	56.8	Bologna	60.0	100	240.[illegible]5
Apple	84.6	100	64.57	Turkey, white meat	58.5	100	187.43
Boiled oatmeal	84.5	100	63.28	Pork and beef sausage	55.4	100	303.67
Pears	84.4	100	64.9	Sardines, canned	52.3	100	277.51
Haddock, fresh	81.0	100	73.3	Corned beef	51.8	100	276.16
Clams, solids	80.8	100	75.0	Ham, boiled, smoked	51.3	100	290.84
Prunes	79.6	100	80.18	Mutton leg, roast	50.9	100	312.68

* Table 18 was prepared by Mary Foley, dietitian of the Mayo Clinic.

own making. Table 18, prepared by Miss Foley[66] of the Mayo Clinic, shows the water content of numerous foods. Table 19 gives the estimations of Magnus-Levy[66] as to the amount of water produced in the metabolism of food.

TABLE 19.—*Amount of Water Formed in Oxidation of Food Stuffs (Magnus-Levy)*

100 Gm. of fat	give	107.1 Gm. of water
100 Gm. of starch	give	55.5 Gm. of water
100 Gm. of protein	give	41.3 Gm. of water
100 Gm. of alcohol	give	117.4 Gm. of water

The importance of water is not limited to its uses as a solvent and medium for chemical change. It serves other important physical purposes as well. The evaporation of water from the lungs and skin is one of the chief factors in the regulation of temperature. Ordinarily about 25 per cent of the heat lost is through vaporization. The amount of this evaporation is influenced by many circumstances; the temperature of the body, the temperature and the relative humidity of the surrounding air, the presence of air currents, and the presence or absence of clothing. Exercise, through increased heat production, leads to the loss of water as sweat, but as a rule insensible perspiration is of greatly more importance than visible sweat.

The major part of the water output passes off through the kidneys, although this is not invariably true, for at times much larger quantities may be lost through evaporation. The quantity of water lost in the urine in health depends, among other factors, on the intake, on the one hand, and on the amount which passes off through skin, lungs and bowels, on the other hand. In health the output of the kidney may vary from 500 to 2,000 or 3,000 cc., and even more. In disease many factors combined to determine the amount of urine; these will be discussed later.

The deprivation of water will within a short time produce great distress; as a rule, it means death within sixty to seventy-two hours. Anhydremia leads to definite renal impairment, as is evidenced by an increase of the nonprotein nitrogen, urea and sugar of the blood. It may lead to poor absorption of food from the bowel and to vomiting and diarrhea. As was shown by Woodyatt,[67] there is profound disturbance of heat regulation accompanied by marked elevation of temperature when anhydremia is produced in animals, a dehydration fever.

Water intoxication is the term given by Larson, Winn and Rowntree to a group of symptoms exhibited by dogs when large amounts of water are administered by the stomach tube. These symptoms include frequency of urination and of bowel movement, nausea, vomiting, tremor and restlessness, ataxia, convulsions and coma. Death followed the continued administration of water. Water intoxication is not to be considered in man except perhaps in the insane.

Unconscious and semiconscious patients as a rule do not get enough water. Because of this neglect great distress and even death may follow. Uncontrollable vomiting or severe diarrhea (Asiatic cholera, colitis in children) may lead to grave anhydremia and death. An adequate supply of water is of infinitely more importance than food or medicine; too much cannot be said of the responsibility of physicians and nurses in assuring the sick person a sufficient intake of fluids.

In the presence of an adequate supply the normal person will secure a sufficient amount of water. In sickness this is not necessarily true. In many diseases close attention must be given to fluid intake and to the balance between intake and output. The manner in which the water is taken is of importance. If the stomach is retentive, it is infinitely better to give fluids by mouth. Otherwise, some other route, such as the bowel, must be chosen. Children will readily absorb large quantities of fluid when it is injected through a needle into the peritoneal cavity. Intraveneous administration is advisable only in an emergency and when other routes are not available.

The proper daily intake of fluids varies within wide limits; from 1,000 to 2,000 cc. of water in the form of drink or as liquid food is appropriate for the healthy man. There is no objection to a larger quantity. In certain diseases it is desirable to increase and in others to decrease this amount.

For further information concerning water balance and anhydremia the reader is referred to the complete discussions of these two related subjects by Rowntree[66] and by Marriott.[68]

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CHAPTER IV

NUTRITIONAL FACTORS OF LESSER IMPORTANCE

SATIETY VALUES

Man eats in order to feel satisfied. He thinks little about the nutritive value of his food, in the selection of which the main question, unconsciously asked, is: "Is this food satisfying?" Therefore, in arranging a diet the physician should always consider the extent to which the food gives a sense of well-being or satisfaction. Kestner[1] has classified foods according to what he terms their "Sättigungswert" —their satiety value.

Several factors no doubt combine to give this sense of satiety; chief among them is the physiologic activity of the digestive tract. Lack of food, with the accompanying rhythmic gastric contractions gives rise to the sensation which we interpret as hunger—even to hunger pains—while a full stomach, physiologically active, produces the opposite feeling, a sense of satisfaction. The mere distention of the stomach is not sufficient to give this feeling of satiety, for it is not experienced when the organ is artificially distended. It is only when the stomach and upper intestines contain food, and when normal muscular and secretory activities are unfolded that this feeling of satiety is experienced. The food which gives this sensation in highest degree and longest is that which remains longest in the stomach and which demands of this organ greatest functional activity.

The rapidity with which the food passes through the small intestines is also of influence, for satiety is greatest and lasts longest when food passes slowly; less satisfaction is experienced when it passes rapidly. Foods as a rule show the same behavior in this respect in both the stomach and the intestine, for those foods which remain longest in the stomach and call forth the greatest secretion of hydrochloric acid, also remain longest in the intestine. For such foods a greater length of time is required in the intestine for the neutralization of the acid which comes from the stomach and therefore longer time for the completion of digestion. The satiety value of an article of diet can therefore be measured in two ways: (*a*) by the length of time the food remains in the stomach, and (*b*) by the amount of gastric juice stimulated by it.

The length of time which various foods remain in the stomach and the amount of secretion called forth by them have been studied on dogs by means of the duodenal fistula. Kestner quotes from Best the figures given in Table 1. It should be noted that the secretion obtained through the fistula is a mixture of gastric juice, bile and pancreatic secretion, of which about two-thirds is gastric juice.

Table 1.—*Length of Time Various Foods Remain in the Stomach of the Dog and Secretion*

	Secretion, Cubic Centimeters	Retained in Stomach
200 Gm. meat cooked in small pieces	1,246	4 hrs.
200 Gm. meat cooked finely chopped	1,203	3½ hrs.
200 Gm. meat boiled	1,186	4½ hrs.
	1,242	4½ hr.
200 Gm. meat raw finely chopped	1,179	3¾ hrs.
250 Gm. boiled ham, in small pieces	517	3 hrs.
250 Gm. boiled ham, finely ground	545	
2 hard boiled eggs	471	2½ hrs.
2 soft boiled eggs	372	1½ hrs.
2 raw eggs	388	70 min. (1⅙ hrs.)
200 Gm. bread	820	2½ hrs.
200 Gm. toast	839	2½ hrs.
263 Gm. boiled potatoes	742	3 hrs.
200 Gm. baked potatoes	1,215	4 hrs.
Test meal contained soup, mashed potatoes, 150 Gm. beefsteak	1,251	3¾ hrs.

The same author quotes Wolfsberg to show the relative increase in gastric secretion when the amount of various articles is doubled.

Table 2.—*Increase in Gastric Secretion When Food Is Doubled*

	Secretion, Cubic Centimeters		Secretion, Cubic Centimeters
100 Gm. meat	244	50 Gm. bread	138
200 Gm. meat	536	100 Gm. bread 140 u	147
50 Gm. meat	289	100 Gm. soft mashed potatoes and butter	300
100 Gm. meat	415		
200 cc. bouillon	91	200 Gm. soft mashed potatoes and butter	340
300 cc. bouillon	210		
200 cc. milk	84	50 Gm. butter	334
300 cc. milk	151	100 Gm. butter	330

It is interesting to note from the foregoing table that meat calls forth an amount of gastric secretion which is directly proportional to the amount eaten, whereas certain other foods, such as bread, potatoes and butter, when eaten in increased amounts do not excite a proportionate increase in gastric juice. This is explained by the fact that in the former instance the exciting agents are chemical—meat extractives—and that the stimulus exerted by them is directly proportional to their amount, while in the latter instance the stimulus to secretion is dependent on psychic influences and therefore may be no greater following the digestion of 100 Gm. of bread than of 50 Gm. This is illustrated in Table 3 in which it may be seen that very little increase occurs in gastric secretion when the amount of potatoes in the diet is doubled, whereas a material increase occurs when the amount of meat is doubled.

TABLE 3.—*Increase in Gastric Secretion on Ingestion of Potatoes and on Ingestion of Meat*

50 Gm. meat and	50 Gm. potatoes	546 cc.	4 hours
50 Gm. meat and	100 Gm. potatoes	512 cc.	6 hours
100 Gm. meat and	50 Gm. potatoes	840 cc.	5½ hours

Thus it is seen that the great importance of meat as a food lies not only in its fuel value and in its ability to replace worn out structures, but also in its quality of calling forth great physiologic activity of the stomach, which in turn gives it great satiety value. It is well known that a meal which contains meat "sticks to the ribs" and lasts longest.

Next to meat in satiety value stands milk; the richer the milk, the greater in this respect is its value. The satisfying quality of eggs depends somewhat on the cooking. Raw eggs leave the stomach much more rapidly than soft-boiled eggs, while those that are hard-boiled remain longest and call forth the greatest amount of secretion. This has been shown by experience. Cooked eggs are to be preferred to raw eggs, not only because they are more easily digested, but also because their satiety value is greater.

Fish is of much lower satiety value than meat or eggs, probably because fish yields less of the stimulating extractives which are obtained from meat. The same applies to oysters, but it does not hold good for the eel and other fish rich in fat.

The satiety value of bread is relatively low; it is still lower when toasted. The addition of butter, however, because of its high fat content, greatly enhances the staying qualities of the bread, which perhaps explains why we prefer to eat our bread buttered. Potatoes belong in the same category as bread, although in isodynamic quantities the former are of definitely higher satiety value. This low rating of bread and potatoes, however, does not hold good under all circumstances for it has been found that when these foods are eaten with meat they have the power of increasing still further the satiety value of the meal.

Green vegetables, such as spinach, lettuce and asparagus, also have relatively low satisfying qualities. Unlike bread and potatoes, they add little to the satiety value of meat.

Fats, such as butter and olive oil, by retarding the emptying of the stomach increase the satiety value of the meal. This quality of fat depends somewhat on its melting point and viscosity. The great satiety value of fat perhaps explains why a salad is more enjoyable when taken with an oil dressing.

The influence of sugar on the satiety value of the diet is of importance. This has been demonstrated by experiment as well as by experience. For instance, a certain test meal containing bouillon, meat, butter and potatoes was given twice, first without sugar and then with sugar. Without sugar the gastric secretion was 1,200 cc. and the evacuation time was three and one-half hours; with sugar, the secretion was 1,288 cc. and the evacuation time eight hours. Thus it is seen that a meal to which something sweet has been added stays longest in the stomach and therefore has greatest satiety value.

It should be noted in this connection that coarse foods which are entirely indigestible, such as bran, paraffin, etc., remain in the stomach only a short time and have no satiety value.[2] It has been shown, too, that indigestible material of this kind when added to the diet leads to an incomplete or subnormal digestion, and therefore to a poorer utilization of the contained protein.[3] The addition to the diet of experimental animals of such indigestible materials as paraffin, filter paper, cork and agar-agar has been found to interfere with the complete utilization of the food. Mendel and Lewis[4] offer the following explanations: (*a*) the rapid emptying of the stomach caused by these articles retards intestinal digestion; (*b*) the adsorption of the partially digested protein residuals renders them less readily accessible to ferments; while (*c*) the adsorption of many digestive products prevents their being taken up by the intestinal villi. This is of interest from a dietetic standpoint because of the custom of prescribing as laxatives such indigestible substances as mineral oil and agar-agar. However beneficial they may be from a medicinal standpoint, these substances retard digestion and carry away with them a certain amount of nutritive material.

The satiety value of the various foods shows that a meal which contains meat gives the greatest degree of satisfaction, and if bread and potatoes are added, particularly the latter, the sense of comfort and well-being is increased. If the bread is buttered, so much the better; and if at the end of the meal something sweet is eaten, its satiety value becomes still greater. Thus is seen the rationale of that type of meal which the race has instinctively chosen: first, a soup (meat extractives); second, meat with potatoes, to which may be added certain other starchy vegetables, then a salad with oil dressing, and finally a dessert. This meal remains longest in the upper gastro-intestinal tract, calls forth the greatest amount of secretory activity, and gives the greatest degree of satisfaction.

ROUGHAGE

The food of man, like that of the lower animals, must contain "roughage"—not only because of the vitamin carrying properties of the rough native foods such as vegetables, but for physical reasons as well.

The stimulus which favors best the functional activity of the large intestine, and which promotes regular evacuation, comes from a large semisolid bowel content. Such a bowel content not only gives the mucous membrane its normal stimulus, but it is also the type of intestinal mass which the intestine can move forward with greatest ease. A more concentrated, dry, solid fecal mass has a different effect; it is irritating rather than stimulating, it is difficult of propulsion, and it tends to accumulate in the haustra, where it may remain for long periods of time.[5] Much of the constipation complained of today is due to a diet which leaves the latter type of residue.

To assure the large semisolid bowel content just described, food of the right kind is essential. With advancing civilization man has gradually changed his diet to one which tends to be more refined and more concentrated; the hull of the grain, the peel of fruits and the abundance of vegetable fiber formerly eaten are now missing. This is wrong. The food that leaves the most satisfactory type of bowel residue contains a great deal of cellulose. This substance resists the action of the digestive ferments and remains behind as an indigestible residue, to be acted on by intestinal bacteria. As it becomes thoroughly macerated, cellulose absorbs water and, under the influence of bacteria, undergoes fermentation. This fermenting material, when mixed with the other fecal matter, gives to the mass the proper bulk and a soft consistency. This is the ideal fecal mass.

For this purpose, any food which contains a large amount of cellulose is suitable. Chief among these are the green vegetables, such as spinach, turnip greens, cabbage, cauliflower, Brussels sprouts, lettuce, celery, peas, beans, etc.; among the fruits, peaches, apples, pears, melons and berries are particularly valuable. The residue is all the greater if fruits are eaten with the peeling.

TABLE 4.—*The Amount of Cellulose Contained in the Commoner Foods*

Fruits	Cellulose Percentage	Vegetables	Cellulose Percentage
		Spinach	1.7
Grapes	4.3	Lima beans, fresh	1.3
Peaches	3.6	Sweet potatoes	1.2
Blackberries	2.5	Cabbage	1.1
Muskmelons	2.1	Carrots	1.1
Strawberries	1.4	White potatoes	0.9
Apples	1.2	Lettuce	0.8
Lemons	1.1	Asparagus	0.7
Bananas	1.0	Tomatoes	0.6
Cherries	0.2	Pumpkins	0.4

Because our cereal grains are usually milled to such a high degree that none of the hull remains, it has become the custom of many people to make up for this deficiency by eating bran, usually as a breakfast dish. Several forms of bran, toasted or otherwise treated, have been placed on the market in elegant form and in fancy packages. Some of these are a little more palatable than ordinary bran, and perhaps they are a little more esthetic, but they are no more effective than the bran which we feed to the cow. This plain ordinary washed bran, when taken with cream and sugar, makes a palatable dish. Bran muffins are popular and wholesome. Below is given the recipe for bran muffins used by a famous hostelry. Puddings made of bran are equally effective. The most satisfactory thing, however, is a breakfast dish of bran, stewed fruit and cream.

Recipe for 2 Dozen Bran Muffins

Eight ounces of bran, 4 ounces of graham flour, 3 ounces of white flour, 1 teaspoonful of baking powder, ½ teaspoonful of salt, 2 eggs, 2 tablespoonfuls of butter, 1 cup of milk.

Occasionally it is difficult to induce the patient to eat a sufficient amount of fruit and green vegetables; or perhaps ulcer of the stomach or other gastro-intestinal disorder contraindicates this type of diet. In such cases agar-agar is effective. This gelatin-like substance, made from Japanese seaweed, absorbs water and when taken into the gastro-intestinal tract increases enormously in bulk. When mixed with the intestinal contents, it provides a mass of the proper bulk and consistency. The dosage of agar must be determined for each person, but as a rule from one to three tablespoonfuls daily is a suffiicent amount. It can be taken "straight;" that is, placed dry in the mouth, mixed with a drink of water and swallowed directly; or, it can be mixed with breakfast food and eaten with cream and sugar. Cascara and phenolphthalein are occasionally incorporated with the agar to enhance its effectiveness. It has seemed to me best to prescribe each separately so that the dose of the drug, if needed, can be varied.

Agar offers a most satisfactory means for restoring the normal consistency of the bowel content when a sufficient amount of cellulose is not available, but there is one important objection to its use. In absorbing water, it calls forth an increased secretion of fluid into the tract and also absorbs a certain amount of the soluble end-products of digestion; it thus deprives the body of these nitrogenous substances. By the administration of agar and similar substances, Hart[6] has been able to produce negative nitrogen balance in animals which otherwise would remain in nitrogen equilibrium. If this effect is understood, it can, by additions to the diet, easily be guarded against. Agar is not a food, but it can be used as an important adjunct to the diet.

To provide, then, an abundance of cellulose, it is usually sufficient to eat each day a dish of bran at breakfast and at the other meals one liberal helping of any salad, two liberal helpings of any green vegetable and a reasonable quantity of fruit. Such a diet not only provides the necessary roughage, but also in large measure the required amount of vitamins.

DIGESTIBILITY

The term digestibility has two meanings: (1) the percentages of the several nutrients of a food which are available to the body for use as fuel or building material—"the coefficient of digestibility;" and (2) the ease with which food is assimilated and the comfort it gives. The word is used in the former sense in scientific literature and in the latter in everyday parlance.

It is surprising what a large part of the food is available for nourishment. Atwater[9] has shown that of the nutrients contained in a mixed diet, the following average amounts are utilized: protein, 92 per cent; fat, 95 per cent; carbohydrate, 97 per cent.

Foodstuffs from animal sources are more completely utilized than those from vegetables.

Of protein from animals, 97 per cent is used; from vegetables, 84 per cent; of fat from animals, 95 per cent is used; from vegetables, 90 per cent; of carbohydrate from animals 98 per cent is used; from vegetables, 97 per cent.

Fat is believed to be particularly difficult to digest. Langworthy,[7] however, in his studies on animal fats found that the coefficients of digestibility range from 97 per cent for butter to 88 per cent for mutton fat. He observed that the presence of considerable quantities of fat in the diet (about 100 Gm.) did not alter the digestibility of the other foodstuffs. For instance, the digestibility of the carbohydrate quota, independent of the nature of the fat and of its amount, remained practically the same, about 97 per cent. The average coefficient of available energy from all sources was approximately the same (91 per cent to 93 per cent), no matter what the nature of the fat, or, within the limits of the experiment, its amount. He concluded that fats do not appreciably influence the digestibility of the other rations.

The interesting observation was made that beef fat differed from the other fats tested (lard, mutton fat and butter) in that it often produced diarrhea when as much as 140 Gm. were taken, whereas the other fats taken in like amounts did not show such a tendency.

The relation of digestibility to the melting point of a given fat was also included in these studies. It was demonstrated, as can be seen in the following table, that fats of low melting point are more completely assimilated than those which are fluid only at a higher temperature.

TABLE 5.—*Comparison of Digestibility and Melting Point**

Fat Studied	Coefficient of Digestibility		Melting Point	
	Determined, Per Cent	With Allowance for Metabolic Products, Per Cent	Authors' Determinations, Degrees Centigrade	Compiled Average Values,[1] Degrees Centigrade
Butter fat	94	97	32.0	28–36
Lard	94	97	35.0	30–44
Beef fat	89	93	45.0	42–50
Mutton fat	80	88	50.0	47–49

* This table is taken from Langworthy, C. F., and Holmes, A. D.: U. S. Dept. Agric. Bull. 310, p. 21.

The completeness with which a food is utilized depends somewhat on its physical state; hence the advantage of cooking. This is illustrated in the experiments of Rose and McLeod, who compared the digestibility of raw egg white with that of cooked egg white. They found that in the same diet the coefficients of digestibility were 80 per cent for the one and 86 per cent for the other. The utilization of raw white, however, is more complete when it is beaten.

Psychic factors do not seem to influence the ultimate utilization of food, for it was found by Hawk and his associates[8] that protein prepared in an unpalatable manner was as completely utilized as that which had been more attractively served.

For the commoner food materials, Atwater[9] found, in a large series of experiments on man, that the fuel value per pound and the coefficients of digestibility were about as follows:

TABLE 6.—*Coefficients of Digestibility and Fuel Value per Pound of Nutrients in Different Groups of Food Materials* (*Atwater*)

Kind of Food	Protein		Fat		Carbohydrates	
	Digestibility, Per Cent	Fuel Value per Pound, Calories	Digestibility, Per Cent	Fuel Value per Pound, Calories	Digestibility, Per Cent	Fuel Value per Pound, Calories
Meats and fish	97	1,940	95	4,040	98	1,730
Eggs	97	1,980	95	4,090	98	1,730
Dairy products	97	1,940	95	3,990	98	1,730
Animal food (of mixed diet)	97	1,940	95	4,050	98	1,730
Cereals	85	1,750	90	3,800	98	1,860
Legumes (dried)	78	1,570	90	3,800	97	1,840
Sugars	...	...	...	...	98	1,750
Starches	...	...	...	...	98	1,860
Vegetables	83	1,410	90	3,800	95	1,800
Fruits	85	1,520	90	3,800	90	1,630
Vegetable foods (of mixed diet)	84	1,840	90	3,800	97	1,820
Total food (of mixed diet)	92	1,820	95	4,050	97	1,820

The ease and comfort with which food is disposed of by the stomach and intestine is what most of us understand as digestibility. This depends on many factors, chiefly on the secretory and motor response which the food calls forth and on the subjective sensation which it produces. The latter is determined in large measure by the former. These several influences in turn are dependent on the physical state of the food, its chemical composition, and its appeal to the appetite. In addition to these factors, digestibility is often governed by idiosyncrasy. This follows no law; it is often psychic, sometimes allergic, and not infrequently of unknown nature.

Hawk and his associates have studied the secretory and motor response called forth by various foods in a number of healthy men.

They assume that the foods which remain in the stomach a shorter time and call forth less secretory response are the more digestible.

Their studies of milk[10] revealed surprising facts. They found that when milk is drunk rapidly it makes smaller curds and leaves the stomach more quickly than when it is slowly sipped. Boiled milk (five minutes) produces a much smaller, softer, more flaky curd, which leaves the stomach sooner and obviously is more digestible, than raw milk. Whole milk gives smaller curds which leave the stomach sooner than those of skim milk; the latter are particularly unyielding and tough. The curds of boiled skim milk are not so tough as those of raw milk, but are not as soft as those from whole milk. Very rich milk retards the emptying of the stomach, but not to as great an extent as skim milk. Pasteurization improves the state of the curd, but not as much as does boiling.

Roast beef,[11] according to these investigators, is handled by the stomach with equal ease whether it is rare, medium or well done. Hamburger steak and stewed beef remain in the stomach about the same length of time as roast beef, but the latter calls forth less rapid development of acidity. Corned beef and dried beef have about the same influence. Calf's liver remains in the stomach a slightly longer time, while frankfurters and sweet breads leave more quickly. One hundred grams of beef remained in the stomach for from two and a half to three and a half hours. Lamb[12] was found to remain in the stomach on an average a few minutes longer than beef but not so long as pork. Sheep brains are evacuated more rapidly. Pork[13] was found to leave the stomach a little more slowly than beef, but it is not retarded to the extent ordinarily believed. Sausage leaves the stomach more quickly than pork chops. Fried ham requires considerably more time. Bacon shows slow emptying time.

Eggs[14] were found to give rise to less stimulation of gastric juice and to leave the stomach sooner than meats; the acidity produced by an egg is only 80 while that of beef is 120. Raw egg white leaves the stomach more rapidly and produces less response than any other egg preparation. The yolk and the whole egg, taken raw have almost the same influence; they stay in the stomach longer and cause more acid than the simple white. Hard boiled eggs remain longer than soft boiled, but the acid response is the same. Shirred and poached eggs have the same effect as soft boiled eggs. Raw whole eggs remain longer in the stomach than boiled eggs, but produce lower acidity. Fried eggs, strange to say, were handled by the stomach in these experiments as easily as boiled eggs. Scrambled eggs or eggs made into an omelet leave the stomach more slowly.

Among the vegetables,[15] it was found that white potatoes whether boiled, creamed, mashed or baked, leave the stomach in moderate time. Potato salad and potato chips are handled with the same ease. Baked potato eaten with butter leaves the stomach sooner than when the butter is omitted. Sweet potatoes, no matter how cooked, remain in the stomach longer than the white variety. Boiled red beets, raw carrots and radishes are quickly evacuated. Boiled carrots remain in the stomach a little longer. Baked beans, perhaps because of the high protein content, remain in the stomach longer than other vegetables and are accompanied by higher acidity. Peas and string beans leave a little more quickly, and cabbage still more rapidly. Lettuce is quickly evacuated; the addition of vinegar or oil causes the stomach to retain them longer. Onions are slower in leaving the stomach than other vegetables with a low protein content. Raw tomatoes and stewed corn leave the stomach rapidly.

These investigators summarize their observations on vegetables as follows: "In general, vegetables low in protein, as carrots, celery, tomatoes, cabbage, lettuce and cucumbers, leave the stomach rapidly, develop moderately high free acid, but little combined acid, and leave the stomach without great change. Boiled vegetables show much more rapid and complete disintegration. Vegetables high in starch, such as potatoes, show considerable starch disintegration before leaving stomach. In certain cases hardly any starch reaction could be obtained towards the end of digestion."

Studies[16] of the digestibility of pies, pastries and puddings show that pie crust properly made is not necessarily difficult for the stomach to handle. Pie crust alone remains in the stomach longer than whole pie. The addition of ice cream to pie makes little difference, but cheese materially lengthens the time that the pie remains in the stomach. It is interesting that in these experiments angel-food cake remained in the stomach longer and called forth higher acidity than did devils food cake; fried cake, such as doughnuts, stayed in the stomach longer; but crisp, light cakes, such as cookies, left the stomach quickly. It was found that puddings leave the stomach rapidly, and that the addition of rice or tapioca hastens the evacuation. Those puddings which have a high protein content, such as Indian pudding and cup custard, develop higher acidities.

In these studies, tea and coffee,[17] whether hot or cold, appeared not to have any effect on the emptying of the stomach; the addition of sugar alone, but not of sugar and cream, delayed this process somewhat. Large quantities of cocoa (1 liter) delayed evacuation. These investigators noted certain unmistakable nervous symptoms when coffee or tea were given in large quantities (1 liter).

Large quantities of cane sugar[18] in concentrated form delay the evacuation of the stomach but smaller quantities in solution have no such effect. Candies taken in large amount have a similar effect; the addition of flavoring extracts and other substances, such as milk, have a modifying effect. Hard candies eaten slowly have little influence, but soft candies have the delaying effect of concentrated sugar solutions. The addition of honey to bread does not influence the evacuation, but the secretion of acid is thereby somewhat delayed.

These investigators[8] studied also psychic influences in their relation to digestion. They found that susceptible persons exhibit marked differences in digestive response. It was evident that the sight of a well set table containing attractive food gives rise to marked secretory activity, while the same food poorly prepared and poorly served calls forth less gastric response. It was found, strange to say, that sight is more influential in this respect than odor, although evil odors seemed to have definite inhibitory effects. The sight and the taste of food, whether or not the odor is perceived, are of identical influence. They found that newspaper reading during the meal had no effect on gastric activity, while anxiety or mental strain materially delayed digestion.

Summary.—The criteria of digestibility adopted by the investigators quoted—the length of time the food remains in the stomach and the amount of secretory response which it calls forth—are fair, but they are not invariably accurate. A notable exception, for instance, is furnished by those foods which are indigestible, such as sand, agar and the hemicelluloses. These call forth little secretory activity and leave the stomach rapidly, more quickly even than the easily digested foods.[19] On the whole, however, these experiments offer the best obtainable evidence of the ease or difficulty with which a food is disposed of by the stomach.

Certain foods are feared because they are believed to be unusually difficult to digest; these merit further discussion.

Many people believe that they cannot drink milk. This is largely psychic; in most instances it means merely that they do not like milk. Milk sometimes causes constipation, but this is easily overcome. There are a few people, very few, who are sensitive to milk proteins; these belong in a class by themselves. In the majority of instances it is best to over-ride the patient's objections to this impor-

TABLE 7.—*Table of Digestibility of the Commoner Foods (Assembled from the Experiments of Hawk and His Associates)*

	Rapid Emptying of Stomach	Slow Emptying of Stomach	Average Acidity
Beef	2 hrs. 35 min.	3 hrs. 35 min.	120
Pork	2 hrs. 45 min.	3 hrs. 40 min.	117
Lamb	2 hrs. 30 min.	3 hrs. 20 min.	134
Eggs	2 hrs. 15 min.	3 hrs. 5 min.	80
Vegetables	2 hrs. 0 min.	2 hrs. 30 min.	70 and 77
Puddings	2 hrs. 18 min.		92
Pies	2 hrs. 27 min.		90
Cakes	3 hrs. 2 min.		90

tant food, and when it is needed insist that he take it. Persistency usually brings good results.

Cheese is believed to be indigestible. This is in part because it is ordinarily eaten between meals and late at night or at the end of a heavy meal when the full amount of protein has already been taken. Experience indicates that if cheese is taken as a protein food and is eaten slowly with the meal, it is handled by the stomach with comparative ease.

Hot breads, when light and well made and eaten slowly, do not deserve their reputation for indigestibility. Pies, when the crust is crisp and well made, not soggy, are well borne.

Concentrated sugar solutions, soft candies, and similar foods, irritate the stomach and interefere with secretory and motor activity. Sweets taken in small amounts, however, at the end of the meal enhance its satiety value and do no harm.

Oils and fats are ordinarily well borne if taken in moderation. Fried foods which are soaked in grease are indigestible because the fat prevents ready access of the digestive juices. If fried in "deep fat," however, which quickly produces a crusty coagulum on the surface and thus prevents the penetration of fat to the interior of the food, they are as a rule well digested.

Cooked foods are more digestible. The cooking of meat loosens the connective tissue so that it is more easily chewed and is of readier access to the gastric juices. Extreme heat long continued, however, has an opposite effect. Another result of cooking is to render meat more attractive and appetizing, which in turn stimulates the digestive organs. Vegetables are not only made more appetizing by cooking, but, what is still more important, the starch cells under the influence of heat burst and permit the digestive juices to reach the contained starch. Breads and cakes are made light by cooking, for the contained gases expand and the water vaporizes to make the mass still lighter; while this is taking place the albumens coagulate and "fix" the bread in this light state. The carbohydrate on the surface is partly caramelized, which gives the whole a more attractive appearance and flavor, and thus renders it more digestible.

A comprehensive statement on the response of the stomach to various foods is given in a recent summary by Rehfuss and associates.[20]

THE COST OF FOOD

In his study of 224 representative American dietaries, Sherman first calls attention to the fact that the more frugally people live, the more they are forced to subsist on grain products. Such a diet, even though it supplies sufficient energy and protein, is faulty because of the poor quality of its proteins and because it fails to supply sufficient calcium and vitamins. To be adequate, a diet of bread and cereals must include also a liberal amount of milk.

At the other extreme, it was found that the richer diets contain a greater proportion of meat and less fruit, butter and eggs. Though rich in protein, such diets are relatively poor in vitamins and calcium. Sherman[21] in stressing the high cost of meat says:

> When people of average income spend as much as a third of their food money for meat, there arises a serious question whether the food budget will then provide for sufficient amounts of milk, butter, vegetables, and fruit to support the best condition of nutrition and the highest degree of health.

In these studies the diets which contain large amounts of fat, as would be expected, were found to be relatively high in calories and low in cost; the expenditure for meat was reduced, while that for vegetables and fruits was increased. Because of their butter content, such combinations are usually rich in vitamin A.

Those diets in which vegetables predominated also included less meat and showed a smaller total cost. Because a liberal quantity of fat is eaten when vegetables are prominent, such diets are relatively high in energy, as well as in mineral and vitamin content, and are low in cost. Since milk and milk products are as a rule included, the protein quota is usually adequate.

Among the less well-to-do, one third or one half of the family budget goes for the purchase of food. It behooves the housewife, then, and others interested in diet, to give thought to the nutritive value received for the money spent. Cost is by no means a fair criterion of nutritive value, for it is influenced by many factors; the perishable nature of the food, its scarcity, the distance it must be transported, its appearance and attractiveness, and the package in which it is sold, all have a bearing on its market value. Thus, the perishable nature of fresh meat is one reason for its high cost; the more desirable cuts give less food for the same money; lettuce in winter and fruit out of season are very expensive; and large red apples and foods in fancy packages cost more than an equal quantity of the same food in less attractive form. It is important that food present a pleasing appearance on the table, but attractiveness on the market often is not worth the money it brings. When strict economy is necessary, articles with fortuitous or artificial values should be avoided. As examples two tables are given below, one illustrating the relative cost of the different cuts of meat and the other the cost of the staple grains as sold in various forms.

TABLE 8.—*Cost of Lean and of Total Meat in the Various Retail Cuts at Market Prices**

Retail Cuts	Diagram Number Fig. 12	Retail Price per Pound of Cut, Cents	Cost per Pound of Lean Meat in Cut, Cents	Cost per Pound of Lean and Fat Meat in Cut, Cents
Steaks				
Porterhouse, hip-bone	8	25	38.6	28.9
Porterhouse, regular	10	25	40.2	27.2
Club steak	18	20	32.1	22.6
Sirloin, butt-end	1	20	25.3	20.6
Sirloin, round-bone	3	20	28.3	21.1
Sirloin, double-bone	5	20	28.7	22.7
Sirloin, hip-bone	7	20	32.3	24.2
Flank steak	1	16	19.3	16.0
Round, first cut	2	15	17.0	15.3
Round, middle cut	6	15	17.3	15.6
Round, last cut	14	15	19.3	16.0
Chuck, first cut	2	12	18.3	14.1
Chuck, last cut	9	12	15.7	13.1
Roasts				
Prime ribs, first cut	1	20	40.5	22.9
Prime ribs, last cut	4	16	26.1	18.8
Chuck, 5th rib	1	15	22.8	17.3
Rump	1	12	19.4	12.8
Boiling and Stewing Pieces				
Round pot roast	16	10	11.6	10.1
Shoulder clod	14	10	12.3	10.5
Shoulder pot roast	11	10	14.3	11.6
Rib ends	3	8	16.2	9.2
Brisket	1	8	15.0	8.7
Navel	2	7	12.8	7.7
Flank stew	2	7	10.9	7.1
Fore shank stew	1	7	8.5	7.0
Neck	15	6	8.5	7.0
Soup Bones				
Round, knuckle	2	5	26.3	12.5
Hind shank, middle cut	18	5	7.5	6.3
Hind shank, hock	19	5	62.5	26.6
Fore shank, knuckle	2	5	17.2	12.5
Fore shank, middle cut	4	5	12.5	9.4
Fore shank, end	6	5	28.8	20.9

* This table is taken from Hall, S. D., and Emmett, N. D.: Univ. of Ill. Agric. Exper. Station Bull. 158, p. 564.

TABLE 9.—*Cost of Meat Required to Furnish One Pound of Protein and* 1,000 *Calories from Wholesale Cuts at Market Prices**

Wholesale Cuts	Retail* Price per Pound, Cents	Boneless Meat in the Cut, Per Cent	Cost of Pound Boneless Meat in Cut, Cents	Cost of Pound Protein in Cut, Cents	Cost of 1,000 Calories in Cut, Cents
Fore shank	5	59.56	8.4	50	7
Hind shank	5	48.84	10.2	63	9
Neck	6	84.31	7.1	46	5
Flank	8	99.44	8.0	85	3
Plate	8	91.23	8.7	82	4
Clod	10	95.18	10.5	63	10
Chuck	11	87.99	12.5	84	9
Rump	12	79.85	15.0	119	8
Round	15	90.39	16.6	101	15
Rib	18	85.56	21.0	171	11
Loin	22	90.23	24.4	188	14

* This table is taken from Hall and Emmett: Univ. of Ill. Agric. Exper. Station Bull. 158, p. 564.

TABLE 10.—*Fuel Values and Cost of Cereals in Packages**

	Total Calories	Protein Calories	Price of Package (Cents)
Rolled oats	2,475	456	10
Flaked wheat	2,495	368	19
Cracked wheat	2,325	491	10
Rice	1,590	145	10
Shredded wheat	1,551	205	13
Cornflakes	1,080	66	10
Puffed rice	702	64	18
Puffed wheat	420	73	14

* This table is taken from Rose, Mary B.: Feeding the Family, New York, The Macmillan Company, 1925, p. 171.

In arranging the dietary and in purchasing food the housewife should consider the relation of cost to the following factors: (*a*) fuel value, (*b*) protein content, (*c*) mineral and vitamin content, and (*d*) palatability and attractiveness. Since American dietaries are particularly likely to be faulty in respect to their mineral and vitamin content, she should reverse the usual order as given above and first of all secure an adequate supply of these two factors.

For richness in minerals and vitamins, milk always comes first. In addition to its other advantages, it provides at a relatively low cost vitamins A, B, and C, and all needed minerals except iron. It is especially rich in calcium. Oatmeal is cheap and is fairly rich in both minerals and vitamins. Dried beans, which cost very little, are not only rich in protein but they contain iron, phosphorus and calcium as well as vitamin B. Spinach and lettuce and the green leaves of cabbage, each provide an abundance of mineral elements and vitamins, and in season they are not costly. Carrots at a low cost furnish vitamins A, B and C. The white potato contains a liberal amount of ash and some vitamins. The tomato, fresh or canned, although it cannot be reckoned as one of the cheaper foods, is of great value because of its vitamins. Oranges, while an excellent source of vitamin C and to less extent of vitamins A and B, are more expensive than these other foods, but are often advisable, especially when other vitamin carrying foods are not obtainable. Apples as a rule cost less than oranges and furnish a fair amount of vitamins A and B.

After an adequate supply of mineral elements and vitamins has been assured, attention should be directed to the caloric value of the diet. Foods having the same fuel value often vary widely in cost. The most economical are the grains and grain products, while the most costly are the perishable foods, such as fish, meats and fruit. The following tables abstracted from the tables of Dr. Rose[22] will illustrate this:

TABLE 11.—*Fuel Values in Relation to Cost* (*Rose*)

A. Some Foods Costing 1 Cent or Less per 100 Calories.
Butter (24 cents per pound)
Corn syrup
Flour, graham
Lard
Bacon (all fat eaten)
Beans, dried
Farina
Lentils
Molasses
Oatmeal
Oats, rolled
Peas, dried split
Pork, salt
Shredded wheat
Wheat, flaked
Rice, (8 cents per pound)
Sugar.

B. Some Foods Costing 1 to 2 Cents per 100 Calories.
Butter (35 to 50 cents per pound)
Chocolate (unsweetened)
Cocoa (Powder)
Crackers, graham
Macaroni
Apples, dried
Butter (52 to 70 cents per pound)
Cheese, American
Chocolate (sweet)
Milk (7 to 13 cents per quart)
Milk (evaporated)
Peanuts
Tapioca (granulated)
Zwieback
Milk (10 to 13 cents per quart)
Olive oil
Peaches, dried
Pecans
Prunes.

TABLE 11.—*Fuel Values in Relation to Cost* (*Rose*) (*Continued*)

C. Some Foods Costing 2 to 3 Cents per 100 Calories.
Eggs (27 to 33 cents per dozen)
Lamb, shoulder
Milk (14 to 17 cents per quart)
Pineapple, canned
Milk (18 to 20 cents per quart)
Onions.
String beans, canned
Buttermilk
Corn, canned
Dates
Milk, powdered

D. Some Foods Costing 3 to 5 Cents per 100 Calories.
Apples
Apricots, canned
Bananas
Beef, chuck (all fat eaten)
Beets
Cabbage
Cauliflower
Cream
Eggs (40 to 67 cents per dozen)
Sardines (canned)
Figs, pressed
Grapefruit
Honey, strained
Olives, green
Pears, canned
Pork chops
Puffed rice
Puffed wheat
Salmon (canned)
Walnuts.

E. Some Foods Costing over 5 Cents per 100 Calories.
Asparagus
Beef, most cuts
Blue fish
Cantaloupe
Carrots (young)
Celery
Cod, fresh
Dried beef
Halibut
Ham, boiled
Lamb chops
Lemons
Lettuce
Olives, ripe
Oranges
Peaches, canned
Pears, fresh
Raspberries
Spinach
Tomatoes, canned
Tuna fish
Turnips, fresh.

In the selection of protein foods the quality of the protein as well as the cost must be considered. The cereal grains and certain of the vegetables, especially the legumes, form economical sources of protein; but their biologic value is low, and such proteins must be supplemented by those of higher quality, such as are found in milk.

The economic value of milk and milk products as a source of protein is often overlooked. It can be shown, after crediting the value of the sugar and fat, that a dollar will buy more protein in the form of milk than in the form of meat. Cheese is especially economical in this respect. For instance, the value of ten cents expressed in calories, when expended for various foods is: for beef 467 calories; for egg 198 calories; for milk 736 calories and for cheese 886 calories. When fresh milk is difficult to obtain and therefore expensive, dry milk will be found an economical substitute. The economic value of milk has been more fully discussed in an earlier chapter.

Those who can afford it (and many who cannot) prefer to take the larger part of their protein in the highly flavored but costly form of meat and eggs. This is often an extravagance, for in many instances money is spent for meat which could with better results go for milk and green vegetables. In defense, however, of the inclusion of meats to the dietary it should be said that meats and fish are more gratifying to the palate and have a distinctly higher satiety value than cereals or vegetables; their proteins are of good quality, and in the vast majority of instances their consumption in reasonable amounts is proper.

The highest degree of efficiency at the lowest cost of protein can be reached by combining milk or milk products with the cereal grains or legumes.

TABLE 12.—*Table Showing the Cost of* 100 *Protein Calories from Different Sources**

Food Material	Cost per Pound	Cost of Portion Yielding 100 Protein Calories
Cheese, cottage	$0.10	$0.020
Oatmeal	0.06	0.021
Beans, dried navy	0.12	0.030
Cornmeal	0.05	0.030
Beans, dried lima	0.12	0.036
Cod, salt	0.22	0.050
Bread, white	0.10	0.060
Bread, graham	0.10	0.062
Peanuts (in shell)	0.30	0.063
Cheese, American	0.35	0.070
Macaroni	0.20	0.082
Milk (10 cents a quart)	0.05	0.085
Lamb, leg	0.30	0.087
Mutton, leg	0.32	0.093
Beef, lean round	0.40	0.108
Halibut	0.40	0.120
Eggs (40 cents per dozen)	0.30	0.120
Milk (15 cents per quart)	0.075	0.312
Porterhouse steak	0.50	0.150
Almonds (shelled)	0.90	0.153
Eggs (60 cents per dozen)	0.45	0.180

* This table is taken from Rose, Mary S.: Feeding the Family, p. 257.

Summary.—From an economical standpoint, the average American diet contains too much meat and not enough milk. When we consider the excellent manner in which milk supplements the cheaper proteins, such as those of grains and legumes, we must recognize that it is our most economical source of protein. All things considered, it is the most economical source of mineral elements and vitamins. Milk has appropriately been referred to as a bargain in food value.

The place which bread and cereals should occupy depends on the size of the budget. When rigid economy is essential, they should be used in large amounts and should be supplemented by milk.

The leafy vegetables should always find a place in the diet, no matter what the budget; fruits should be included if possible.

Numerous formulas for economy and efficiency in diet have been devised. One generally accepted rule calls for a quart of milk for each child and a pint for the adult. Sherman suggests that after sufficient milk (including milk products) has been purchased, the allowance for food should then be divided into three approximately equal parts: one for fruits and vegetables, one for cereals, bread and butter, and one for meat, eggs, sweets and miscellaneous. He also[23] enunciates two excellent rules which should govern the purchase of food whether the budget be restricted or liberal.

> (1) At least as much should be spent for milk (including cream and cheese if used) as for meats, poultry, and fish, and (2) at least as much should be spent for fruits and vegetables as for meats, poultry, and fish.

The following menus of varying cost were arranged by Dr. Mary S. Rose[22] for a family of eight:

TABLE 13.—*Family Dietary Number I* (*Rose*)

Fuel Value: about 14,600 Calories Cost: 2–2½ c. per 100 Calories

Food	Measure	Protein Calories	Total Calories
BREAKFAST:			
Milk for baby	1 cup	34	170
Milk for 3-year-old	1 cup	34	170
Wheatena for 3-year-old*	4 tbsp.	4	33
Orange juice for baby	2 tbsp.	.....	22
Orange juice for 3-year-old	3 tbsp.	.....	33
Oranges for 6	3 large	20	300
Wheatena for 6*	3 ⅞cups	63	525
Omelet for 6			
Eggs	4 eggs	100	280
Milk	½ cup	17	85
Bacon	12 small pieces	39	300
Toast for 6	10 slices bread	70	500
Butter for 6	5 tbsp.	5	500
Milk for older children	3 cups	102	510
Milk for coffee† and cereal	3 cups	102	510
Sugar for coffee	2 tbsp. (scant)	.....	100
Coffee for adults			
			4,038
LUNCHES:			
10 A. M.			
For baby:			
Wheatena jelly	2 tbsp.	3	16
Milk for jelly	¼ cup	34	170
Milk to drink	¾ cup		
For 3-year-old:			
Milk	¾ cup	26	127
Bread	1 slice	7	50
For 6-year-old:			
Milk	¾ cup	26	127
Crackers	2 crackers	5	50
			540
FAMILY LUNCHEON (FOR 6):			
Creamed chicken	1½ cups	144	900
on toast	6 slices		
Baked bananas	6 bananas	30	600
Boston brown bread	10 slices	50	500
Butter	5 tbsp.	5	500
Rice pudding	1½ cups	72	600
Milk for children	3 cups	102	510
Sugar for tea	2 tbsp.	.....	100
Tea for adults			
			3,710

TABLE 13.—*Family Dietary Number I (Rose) (Continued)*

Food	Measure	Protein Calories	Total Calories
AFTERNOON MEALS:			
2 P. M.			
For baby:			
Egg yolk	1 yolk	11	56
Bread	½ slice	3	25
Milk	1 cup	34	170
Sifted pea pulp	1 tsp.	1	4
Baked potato	½ small	3	25
Prune pulp	1 tbsp.	1	50
For 3-year-old:			
Egg	1 egg	25	70
Toast	1 slice	7	50
Baked potato	1 small	6	50
Butter	1 tsp.	.....	33
Sifted pea pulp	2 tbsp.	6	20
Rice pudding II	¼ cup	12	100
Milk	¾ cup	26	127
			780
5.30 P. M.			
For baby:			
Wheatena jelly	2 tbsp.	3	16
Milk for cereal	¼ cup	34	170
Milk to drink	¾ cup		
Bread	½ slice	4	25
For 3-year-old:			
Steamed rice	¼ cup	3	33
Milk for rice	⅓ cup	11	56
Bread	1 slice	7	50
Butter	1 tbsp.	.....	33
Apple snow	2 tbsp.	.....	15
Boiled custard	⅓ cup	13	100
Milk to drink	¾ cup	26	127
For 6-year old:			
Steamed rice	½ cup	6	66
Milk for rice	½ cup	17	85
Bread	2 slices	14	100
Apple snow	3 tbsp.	2	33
Boiled custard	⅓ cup.	13	100
Lady fingers	2 fingers	10	100
Milk to drink	¾ cup	26	127
			1,236
FAMILY DINNER:			
Bouillon for 5	3 cups	63	75
Baked halibut for 5	21 oz. (raw wt.)	366	600
Egg sauce for 4			
white sauce	1 cup	57	470
egg	1 egg		

TABLE 13.—*Family Dietary Number I (Rose) (Continued)*

Food	Measure	Protein Calories	Total Calories
FAMILY DINNER—Continued:			
Potatoes on half shell for 4			
potatoes	4 medium	62	656
butter	2 tbsp.		
milk	¼ cup		
Buttered string beans for 5			
beans	2¼ cups	23	200
butter	1 tbsp.		
Bread for 5	6 slices	42	300
Butter for 5	3 tbsp.	3	300
Tomato salad for 4			
tomatoes	4 medium	20	416
lettuce	8 leaves		
French dressing	4½ tbsp.‡		
Apple snow for 5	2 cups	18	300
with boiled custard	1⅔ cups	65	500
Lady fingers for 4	8 fingers	40	400
			4,217
NIGHT LUNCH FOR GRANDMOTHER: 10 P. M.			
Hot milk	¾ cup	26	127
Cracker	1 cracker	3	25
			152
Total for day		2,206	14,673

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* Cf. farina.

† The milk is estimated as whole milk throughout, assuming that it will be skimmed, the top used for coffee, cereal, and pudding, and the rest for cooking and drinking.

‡ 7½ tbs. served; 3 tbs. lost on plates.

TABLE 14.—*Family Dietary Number IV (Rose)*

Fuel Value: about 14,300 Calories — Cost: 1¼ c. per 100 Calories

Food	Measure	Protein Calories	Total Calories
BREAKFAST:			
Milk for baby	1 cup	34	170
Orange juice for baby	2 tbsp.	.....	22
Milk for 3-year-old	1 cup	34	170
Oatmeal for 3-year-old	½ cup	9	50
Orange juice for 3-year-old and 6-year-old	6 tbsp.	.....	66
Cornmeal mush for 6	3⅓ cups	50	500
Dried apple sauce for 5	2¼ cups	6	600
Sausage for 2	¼ lb. (raw wt.)*	100	500
Bread for 6	12 slices	84	600
Milk for cereal coffee for children aged 6, 9, 11	1½ cups	51	255
Milk for coffee for adults	½ cup	17	85
Milk for mush	2 cups	68	340
Sugar	8 tbsp.	.....	480
			3,838
LUNCHES:			
10 A. M.			
For baby:			
Oatmeal jelly	2 tbsp.	3	16
Milk for jelly	¼ cup	34	170
Milk to drink	¾ cup		
For 3-year-old:			
Milk	¾ cup	26	127
Bread	1 slice	7	50
For 6-year-old:			
Milk	½ cup	17	85
Crackers	4 crackers	10	100
			548
FAMILY LUNCHEON (FOR 6):			
Baked samp with cheese	4½ cups	132	953
Boston brown bread	10 slices	50	500
Oleomargarine	5 tbsp.	5	500
Stewed raisins	2 cups	18	600
Oatmeal wafers	8 wafers	88	800
Cocoa for children	3 cups	70	500
Sugar for adults' tea	2 tbsp. (scant)	.....	100
Tea for adults			
			3,953
AFTERNOON MEALS:			
2 P. M.			
For baby:			
Milk	1 cup	34	170

TABLE 14.—*Family Dietary Number IV (Rose) (Continued)*

Food	Measure	Protein Calories	Total Calories
AFTERNOON MEALS—Continued:			
Bread	½ slice	3	25
Sifted pea pulp	1 tsp.	1	4
Baked potato	½ small	3	25
Prune pulp	1 tbsp.	.....	50
For 3-year-old:			
Split pea soup	⅗ cup	26	100
Bread	2 slices	14	100
Oleomargarine	2 tsp.	.....	66
Baked potato	1 small	9	75
Baked apple	1 small	1	75
Milk to drink	½ cup	16	85
			775
5.30 P. M.			
For baby:			
Oatmeal jelly	3 tbsp.	4	25
Milk for jelly	½ cup	42	212
Milk to drink	¾ cup		
For 3-year-old:			
Cream toast	1 slice 6 tbsp. sauce	20	150
Bread	1 slice	7	50
Oleomargarine	1 tsp.	.....	33
Rice pudding	⅖ cup	8	100
Sugar for pudding	1 tsp.	.....	20
Milk for pudding	¼ cup	34	170
Milk to drink	¾ cup		
For 6-year-old:			
Cream toast	1½ slices ½ cup sauce	33	250
Rice pudding	⅘ cup	16	200
Milk for pudding	½ cup	16	84
Sugar for pudding	2 tsp.	.....	40
			1,334
FAMILY DINNER (FOR 5):			
Beef stew with vegetables	4¾ cup	183	1,132
Bread	10 slices	70	500
Oleomargarine	5 tbsp.	5	500
Date pudding I	5 servings	50	1,000
Brown sugar sauce	2½ cups	.....	660
			3,792
NIGHT LUNCH FOR GRANDMOTHER:			
10 P. M.			
Tea with ½ cup hot milk	1 cup	17	85

TABLE 14.—*Family Dietary Number IV* (*Rose*) (*Continued*)

Food	Measure	Protein Calories	Total Calories
NIGHT LUNCH FOR GRANDMOTHER — Continued:			
Sugar for tea	2 tsp.	.....	40
Cracker	1 cracker	3	25
			150
Total for day	....	1,528	14,390

* Fat used on bread.

TABLE 15.—*Menus for Very Low-priced Family Dietaries* (*Allowing Three Quarts of Milk per Day*) (*Rose*)

I. BREAKFAST:
  - Cornmeal mush { fried and served with corn syrup for adults / steamed and served with milk for children
  - Bread
  - Oleomargarine
  - Coffee for adults
  - Apple sauce or orange juice for 3-year-old; orange juice for baby

LUNCHEON OR SUPPER:
  - Pork and beans—bean and tomato soup for young children
  - Stewed tomatoes
  - Bread
  - Oleomargarine
  - Tea with milk and sugar for adults
  - Milk for youngest children
  - Cereal coffee or cocoa for older children

DINNER:
  - Liver
  - Hashed browned potatoes
  - Bread
  - Oleomargarine
  - Tea for adults
  - Milk for youngest children
  - Dried apple and date pie with cheese, for father, mother, and oldest child
  - Dried apple sauce for others

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SECTION B

Food Products

CHAPTER V

MILK AND MILK PRODUCTS

Because of the peculiar position it occupies as a complete food, milk is singled out for separate consideration. In the discussions which follow, except when otherwise specified, the word milk will refer to cow's milk.

Milk is the most important of all foods. It is indispensable to the infant, it is essential to the proper development of the young child, and it should form invariably the chief article of diet for the older child. For the adult, too, it is always a valuable, and at times a well nigh essential, adjunct to the diet. Milk has never been accorded adequate place in the American dietary.

Physical Properties.—Milk is a yellowish white liquid of sweetish taste and characteristic odor. It is a solution of albumens, sugar, mineral salts and other substances, and an emulsion of fat. The fat droplets give to milk its whitish appearance; when permitted to stand, they rise to the top in the form of cream. The specific gravity of milk varies from 1,028 to 1,034; its freezing point from –0.53° C. to –0.58° C. Its reaction is just on the alkaline side of neutrality, with a hydrogen ion concentration of $p_{\mathrm{H}_{6.58}}$.

Chemistry.—The composition of milk is influenced in a small degree by race, course of lactation, season, ration and the individual characteristics of the cow. The character of the fat as well as its amount is determined to some extent by diet; for foreign fats eaten by the cow may appear as such in her milk. The disagreeable taste sometimes acquired by milk in the spring is due to certain weeds which have been eaten by the cow. The influence of food on the amount and character of milk in general will be more fully considered in a discussion of the dietary needs of the nursing human mother.

The average composition of cow's milk is about as given in Table 1.[1]

The proteins of milk are of the highest quality; that is, they supply all of the amino-acids necessary for successful nutrition. They rank in this respect with the proteins of meat, and are greatly superior to those of the cereal grains and vegetables. Milk proteins are of good supplementary value also, for when added to those of wheat or other grains they enhance the nutritive value of the ration, and render adequate a diet which would otherwise be faulty in respect to its amino-acid content. It has been found that skim milk added to the corn ration of swine makes an ideal food and promotes growth better than any other food mixture yet devised. The nutritive value of man's diet is greatly increased by the addition of milk to his cereals and wheat bread.

Table 1.—*Average Composition of Cow's Milk*

	Percentage	Limits of Variation, Percentage
Water	87.7	83–91
Solids	12.2	9–17
Fat	3.4	2–8
Casein	2.7	2–4.5
Lactalbumin	0.5	0–2–1.3
Lactglobulin		
Other nitrogen bodies	0.2	
Milk sugar	4.7	3.0–6.6
Ash	0.7	0.6–1

Milk contains several proteins; three are well known; caseinogen, lactalbumin and lactglobulin. The most important of these is casein, because: it is five times more abundant than the others; it is highest in biologic value, and it makes possible the preservation of milk proteins and fat in the form of cheese. Caseinogen, a phosphoprotein, is the precursor of casein. Being a colloidal body, it is capable of numerous complex physicochemical changes. It is precipitated by dilute acids, but can be redissolved by an excess of acid. It is also dissolved by alkalis. In the souring and coagulation of milk which accompanies lactic acid formation insoluble casein appears as the result of the precipitation of caseinogen. The stability of these protein bodies is no doubt preserved in large degree by the mineral salts of the milk; any change in the equilibrium of the latter results in physicochemical changes in the former. Caseinogen can be coagulated also by the ferment rennin in the presence of calcium, which results in a splitting of the molecule into a soluble and an insoluble body; the latter is casein. In the absence of calcium, rennin does not bring about coagulation; if calcium is added later, even though the rennin has been destroyed by heat, coagulation takes place.

Lactalbumin and lactglobulin are present in much smaller amounts and are of lesser importance. The former is peculiar to milk; it is not so complete a protein as casein, and therefore is of lower biologic value. The latter is identical with serum globulin.

The carbohydrate of milk is in the form of lactose, or milk sugar. This sugar is probably synthesized from dextrose by the milk glands, or perhaps by a stereochemical rearrangement of the maltose molecule.

Lactose is a disaccharide and is split on digestion into glucose and galactose, one molecule of each. It is dextrorotary. It is not as sweet as cane sugar; this fact is extensively made use of where, as in the feeding of typhoid fever patients, it is desired to give a high calory carbohydrate diet. Lactose is an important factor in the souring of milk; under the influence of bacteria it ferments with the production of lactic acid. Its amount is constant and is largely independent of the cow's ration. Dextrose and other carbohydrates in minute amounts have also been found in cow's milk.

Milk fat consists of a mixture of fats, largely the triglycerides of palmitic, oleic and butyric acids. The relative proportion of these fatty acids is given in Table 2.[2]

TABLE 2.—*Fatty Acids in Milk Fat**

Butyric	5.45
Caproic	2.09
Caprylic	0.49
Capric	0.32
Lauric	2.57
Myristic	9.89
Palmitic	38.61
Stearic	1.83
Distearic	1.04
Oleic	32.50

* This table is taken from Oppenheimers' Handbuch der Biochemie, 1910, p. 395.

This fat is emulsified in the form of extremely fine droplets, from 2 to 4 microns in diameter; an enveloping membrane for these has been described. The size of the droplet depends on the breed of the cow and determines the digestibility (or absorbability) of the fat. Milk fat is produced by the milk glands; it may come directly from the fat of the blood or may arise through the conversion of glucose into fat. It has been definitely proved that the identical fat of the diet may appear in the milk in the exact stereochemical form in which it was eaten. Small amounts of lecithin and cholesterol have also been found in milk. On standing, the fat rises to the top of the milk and is known as cream.

The mineral elements, in which the milk is rich, add greatly to its value. Approximately 0.7 per cent of milk is ash. The percentage of these elements in whole milk is as follows:[3] calcium, 0.120; magnesium, 0.012; potassium, 0.143; sodium, 0.051; phosphorus, 0.093; chlorine, 0.106; sulphur, 0.034, and iron, 0.00024.

The mineral elements exist in milk in several forms: (*a*) as salts, chiefly as the salts of phosphoric, sulphuric, hydrochloric and citric acids; (*b*) as the dissociated ion, and (*c*) in more or less intimate chemical and physicochemical union with proteins and other organic bodies. The base-forming are slightly in excess of the acid-forming elements.

The most valuable of these elements to man is calcium. It is needed by the growing child in large amounts and by the adult as well; yet it is often lacking in the average mixed diet.

Milk is poor in iron, but even the small amount present is of value and should not be disregarded. In diluting cow's milk in order to reduce its protein content for infant feeding, it must not be forgotten that its mineral content can thus be reduced to a dangerous extent. It has been suggested that this be corrected by the use of whey as a diluent.

The vitamin content of milk contributes to its nutritive value. It is especially rich in vitamins A and B, being one of the most satisfactory sources of the former. Vitamin C is present in variable amounts. The food of the cow influences profoundly the richness of her milk in vitamins; if she is permitted to graze in good pastures or is fed on silage, her milk contains more vitamins than if she is grain-fed. Kennedy and Dutcher[4] recently published conclusions, based on extensive investigations, to the effect that even stall-fed animals will give a milk rich in vitamins A and B if the ration properly combines grains, silage and legume hay. The heating of milk destroys a part of the vitamins, especially vitamin C.

Other substances are found in milk. Several ferments have been described: sugar splitting, lipolytic and proteolytic ferments, as well as an oxydase and a peroxydase. Milk contains coloring substances, among which is a red "lactochrome" and a yellow "lipochrome." The chlorophyl of the cow's food contributes largely to the formation of this coloring matter.

Cream.—Cream is the fat of the milk which has been separated by gravity or by centrifugal force. In the modern dairy industry the latter method of separation is used, and cream of almost any richness, up to 60 per cent of fat, may be obtained. Most states require that cream sold in the market contain at least 18 per cent of fat and no substance foreign to normal milk. Because cream must be a little older than milk sold at the same time, a higher bacterial count is permitted.

COMPARISON OF THE MILK OF DIFFERENT SPECIES

The composition of milk varies according to the species from which it comes. To a less extent it also shows racial and even individual characteristics.

The milk of each species is especially adapted in mineral content, as in other respects, to the uses of its own young. A comparison of the mineral elements contained in the bodies of new-born animals with the ash of the milk from the same species shows remarkable adaptation of milk to the particular need it is expected to serve.

The more rapidly growing animals secrete milk which is richer in protein and in mineral content than that of the animals which mature more slowly. This is illustrated in Table 3.

TABLE 3.—*Rate of Growth and Composition of Milk**

	Time in Which Weight Is Doubled (Days)	100 Parts Milk Contain—			
		Protein	Ash	Lime	Phosphoric Acid
Human	180	1.0	0.2	0.032	0.047
Horse	60	2.0	0.4	0.124	0.131
Calf	47	3.5	0.7	0.160	0.197
Goat	19	4.3	0.8	0.210	0.322
Pig	18	5.9			
Sheep	10	6.5	0.9	0.272	0.412
Cat	9½	7.0	1.0		
Dog	8	7.3	1.3	0.453	0.493
Rabbit	7	10.4	2.4	0.891	0.996

* This table is taken from Myers, V. C.: Body Tissues and Fluids, in Barker: Endocrinology and Metabolism, New York, D. Appleton & Co. **3**: 477, 1922.

Mother's milk is of course the ideal food for the infant. When this cannot be obtained, cow's milk is usually modified in order to make it resemble human milk as closely as possible. In certain countries the milk of other animals is used, particularly that of the goat, of the mare and of the burro. Burro's milk in many respects resembles mother's milk more closely than that of other animals, although its fat content is relatively low.

The manner in which human milk differs from cow's milk is of particular interest. The casein content of the former is less than that of the latter, although the amount of albumen is greater. The relative proportion of casein to albumen in human milk is as 40 to 60 and in cow's milk as 85 to 15. The casein of human milk is more difficult to precipitate both with acids and salts; even with rennin coagulation is more difficult than in cow's milk. After precipitation with acids the casein of human milk is more easily redissolved by an excess of acid. The coagulum of human milk is lighter than that of cow's milk, and for this reason has been regarded as more digestible; this belief is not universally accepted. The fats of human milk are poorer in volatile fatty acids; the droplets are larger. The percentage of milk sugar is greater in human than in cow's milk. Human milk is poorer in mineral matter, having only about one-sixth the calcium of cow's milk, but it is believed that the salts of the former are in a more utilizable form. The iron content of human milk is slightly greater, 0.00037 per cent.

Table 4.—*The Average Composition of Milk from Several Species**

	Water	Solids	Fat	Casein	Total Nitrogenous Bodies	Sugar	Ash
Human milk (173 analyses)	87.58	12.42	3.74	0.80	2.01	6.37	0.30
Cow milk	87.80	12.20	3.40	2.70	3.40	4.70	0.70
Buffalo milk	82.30	17.70	7.70		4.80	4.40	0.80
Camel milk	87.60	12.40	5.38	2.98	.....	3.26	0.70
Goat milk	86.30	13.70	4.00	3.60	4.60	4.30	0.80
Sheep milk	81.50	18.50	7.00	4.30	5.60	5.00	0.90
Mare milk	90.58	9.42	1.14	....	2.05	5.87	0.36
Burro milk	90.12	9.88	1.37	0.79	1.85	6.19	0.47
Rabbit milk	69.50	30.50	10.45	....	15.54	1.95	2.56
Guinea-pig milk	41.11	58.89	45.80	....	11.19	1.33	0.57
Swine milk	82.37	17.63	6.44	....	6.09	4.04	1.06
Dog milk	77.00	23.00	9.26	4.15	9.72	3.11	0.91
Cat milk	81.64	18.36	3.33	3.11	9.53	4.91	0.59

* This table is taken from Völtz, W., in Oppenheimer: Handbuch der Biochemie, 1910, p. 403.

THE DIGESTION OF MILK

The first step in the digestion of milk consists in the coagulation of caseinogen by the ferment rennin. The change which caseinogen first undergoes in this process has been variously described as follows: (*a*) rearrangement within the molecule; (*b*) union of several molecules into a larger one; (*c*) splitting into two molecules, one of casein, and another of a different character, both of them soluble or (*d*) hydrolytic splitting into two soluble casein molecules. The last theory is generally accepted. According to this view, casein when first formed is soluble, but it immediately unites with calcium salts to form insoluble casein or calcium caseinate. The coagulum is light and flocculent if, as occurs in the stomach, the milk is thoroughly agitated. Fat droplets are caught into the mesh of the curd and determine somewhat its physical characteristics. At this point, as the acidity of the gastric juice increases, pepsin exerts its proteolytic action and splits casein into its soluble cleavage products; these are carried into the small intestine and undergo further digestion by trypsin and erepsin.

Abderhalden[5] calls attention to the biologic significance of coagulation. Milk, the sole food of the infant, reaches the stomach in a fluid state, and, unless stayed in its progress, would immediately pass in overwhelming amounts into the duodenum. Rennin, in thus coagulating the caseinogen, keeps the milk in the stomach for a time and permits the partially digested casein to be passed little by little into the small intestine.

No doubt, too, the fat droplets are more easily acted on when caught in this coagulum. Some of the emulsified fat droplets are acted on by the lipase of the stomach and are split into glycerine and fatty acids; most of the fat, however, is digested in the intestine. Milk fat, both because of its low melting point and the ease with which it is emulsified, is more readily digested than fats from other sources.

Milk is the most digestible of all foods, if by digestibility we mean the completeness with which the contained foodstuffs are assimilated and the ease and comfort with which this is accomplished. When taken by the adult in large quantities, milk is more completely digested if mixed with other foods; a graham cracker, for instance, probably enhances the nutritive value of a glass of milk taken between meals.

Many people say that they cannot take milk. This is seldom true. A few are sensitive to milk proteins and show anaphylactic reaction when these are taken, but such people are rare. Many find milk distasteful, and these as a rule are the ones who say that they cannot drink it. It is a psychic rather than a digestive problem, and the physician who would nourish his patient properly must strive to overcome such phobias. With firmness it can be accomplished.

THE NUTRITIONAL VALUE OF MILK

The great nutritional value of milk is due to the high quality of its proteins, to its richness in mineral elements and vitamins, and to the easy digestibility of its fats. It protects against nutritional failure, and therefore is classed among the protective foods. Animal experiment has furnished abundant proof of the importance of milk to the growing organism.

In order to secure comparable evidence for man, McCollum[6] carried out on a group of eighty-four children a series of experiments covering a considerable period of time. These children lived in an orphanage where sanitary conditions were satisfactory and the diet was adequate, except that it was lacking in milk and green vegetables. To the diet of each child in one subgroup of forty-two there was added one quart of reconstituted milk (Klim) daily; a control group of the same number received no milk. The improvement in growth and well-being of the former as compared with the latter group was prompt and striking. Many children increased 50 per cent in weight (one child 90 per cent) during the first year of the experiment.

Sherman[7] reports similar experiments along somewhat different lines. His object was to determine the optimum amount of milk for children, and he took as his criterion the development of bones and teeth as evidenced by the storage of calcium and phosphorus. The experiments were carried out under ideal conditions on children of from 3 to 13 years of age. He says:

> The results as a whole emphasize strongly and in most convincing fashion the importance of the quantity of milk consumed. We may well devote ourselves to the effort of insuring the consumption by every growing child of the equivalent in some form of a quart of whole milk per day.
>
> In view of such evidence it seems a mistake to limit the recommendation of a quart of milk per day to the ages from infancy to puberty. Undoubtedly it would better be extended, probably to all ages. Certainly it seems to me the boy should have his quart of milk per day until he is a man full grown, and the girl should continue to take her quart of milk per day until as a woman she has weaned her last child.

McCollum[8] has discussed in a convincing manner the superior physical development and greater stamina of pastoral peoples who live largely on milk and milk products. He says:

> The Aryans and Mongols developed in the high pasture lands of Central Asia, where agriculture did not yield a return for labor, and where the care of flocks and herds formed the chief means of subsistence. Here in a climate characterized by extremes of heat and cold and of drought have originated the virile peoples who have become the possessors of the lands in every direction where the climate and soil were more favorable to an easy existence. Abstemious nomads, who knew no indulgence, and were every few years brought to face disaster through a scantier rainfall than usual, left their homes in wave after wave and dispossessed their neighbors in more favored lands. But in those more favorable circumstances where they came as conquerors, they not infrequently, in time degenerated into ease-loving agriculturists.

This author calls attention to the wonderful physique and the courage of the Arabs whose diet consists in large part of milk and milk products obtained from their flocks; he contrasts the splendidly developed people of Sweden—where there is approximately one cow to every two inhabitants—and of Switzerland, to the people of other lands where there are fewer cows. His comparisons of physical beauty, mental qualities and longevity are very much in favor of those people who own flocks and consume milk.

The amount of milk consumed by the adult has an important bearing both on the health of the community and on its wealth. It has been estimated that a pint of milk a day represents for the adult the minimum of nutritive safety and that a quart is the optimal amount; this includes not only milk taken as such but also that used in cooking. The foregoing estimate comes from the combined experience of students of nutrition, of physicians and of various relief agencies, all reaching the same conclusion from observations in widely differing fields. It is universally accepted. The milk consumption of urban and, surburban communities in America is far below this minimum. In 1900 the consumption of milk, exclusive of that used in butter and other milk products, was about one half pint a day per capita. New York City consumed slightly more than this in 1923. Many cities report much lower amounts. Improvement, however, in the milk supply, and educational propaganda have led many communities to a steady increase in milk consumption, and the slogan "drink a quart of milk a day" is attracting ever increasing attention.

ECONOMY

Milk is an economical food, a fact which is not generally recognized. It can be easily shown, even with figures which assume the highest cost for milk, and which credit butter fat and milk sugar with low market values, that the protein of milk costs less than that of lean beef. In comparing milk with eggs by a similar computation, it can be shown that milk is the cheaper. These figures place no monetary value on the vitamins of milk which are of great nutritive value, nor do they take into consideration the high biologic worth of is proteins and its richness in mineral elements. To quote Haven Emerson: "Milk purchased even at the present higher level of prices is a bargain in food value."

The economical value of milk and meat may be compared in another way. The energy contained in each comes in last analysis from the food which the animal eats. It is estimated that a good milk cow returns in the form of milk 20 per cent of the energy of her food, and the poor cow 12 per cent, while the beef steer returns in the form of meat only 6 per cent of the energy he consumes. Crops grown on a given acreage will yield for human consumption four or five times as much protein and energy when fed to dairy cows as when used for beef production.[9] It is noteworthy, too, that the dairy cow is not only highly efficient in her yield of energy, but she is also able to transmit for human consumption to a much greater degree than the beef steer the vitamins and mineral elements of her food.

This is not an argument against the use of meat, for meat has an important—an almost essential—place in the dietary; it is a plea for the more liberal use of milk and milk products as supplementary articles of diet, a plea which is based on both nutritional and economic considerations. The health of the nation and its wealth can both be served by the cultivation of the dairy industry.

ADULTERATION OF MILK

The adulteration of commercial milk for profit has been extensively practiced in the past, but, thanks to the rigid control exercised by public health officials, it is rare today. Adulteration is accomplished in two ways: by the addition of water, and by removal of the cream. Until recently such practices could be recognized only by analysis of the milk or by means of the refractometer, neither of which methods is infallible. Recently it has been found that cryoscopy will detect with accuracy the addition of even very small amounts of water. The freezing point of milk is a physiologic constant lying between $-0.530°$ C. and $-0.566°$ C.; the addition of a foreign substance is revealed by a prompt change in this figure.

THE BACTERIA OF MILK

Milk which comes direct from the clean udder of a healthy cow contains very few bacteria, perhaps only 500 or less per cubic centimeter. Contamination, however, takes place easily, for milk is an excellent culture medium, and the organisms which gain access grow rapidly. The bacteria found in milk are as a rule nonpathogenic, but pathogenic varieties sometimes appear. Even those strains which are classed as nonpathogenic may cause grave illness in infants.

Contaminating bacteria cause the decomposition of milk; the proteins are decomposed and the lactose undergoes lactic acid or alcoholic fermentation. Predominance of *Bacillus lactis* with resulting lactic acid fermentation retards the development of putrefactive and pathogenic organisms.

Bacterial contamination may come from a diseased udder or other focus, from the hands of the milker or dairy worker, from the atmosphere or from the vessels with which the milk comes in contact. Often several of these sources are the cause. The most dangerous of these to the adult user of milk is an infected dairy attendant—a typhoid carrier, for instance. With rigid care in the inspection of herds and the examination of dairy attendants, as well as in the handling of the milk, such contamination can be avoided, and the bacterial count can be held to a very low figure.

THE CARE OF MILK

Essential to the safe handling of milk is the use of covered containers and the maintenance of a low temperature. It should be delivered in closed bottles and kept in these until ready for use. Open vessels are bad. The practice of serving milk at the table in the original bottle in which it was delivered is an excellent one and should be encouraged. If the temperature of the milk is reduced to 50 F. soon after it is obtained from the cow, and if it is maintained at this temperature or a lower one it can be kept sweet a long time. Milk should remain packed in ice during the rounds of the milkman, and should be placed in a clean refrigerator immediately on delivery.

Most departments of health have adopted stringent rules regarding the production and distribution of milk. These rules concern the health and cleanliness of the cow, the health and cleanliness of the dairy workers, the sanitary condition of the barns and surroundings, and the manner in which the milk is distributed to the customer. The dairyman who does not meet these requirements and whose product does not conform to bacteriologic standards is, as a rule, refused a license. In New York City,[10] grade "A" raw milk must have come from a healthy tuberculin-tested herd and have been obtained in a dairy scoring at least 25 points on equipment and 50 points on method; the bacterial count must not exceed 60,000 to the cubic centimeter, and the milk must be delivered in bottles within thirty-six hours. Grade "A" pasteurized milk must be obtained under similar conditions with a score of at least 25 per cent on equipment and 43 per cent on method. It must not contain more than 30,000 bacteria to the cubic centimeter, and no raw milk with a bacterial count in excess of 200,000 shall be used in its production. It must be delivered in properly labeled bottles and must be sold within thirty-six hours after pasteurization.

From a standpoint of cleanliness, certified milk represents the ideal. This has been defined as "clean, unprocessed milk of uniform composition from healthy cows, and carefully guarded against disease or contamination."[11] The term "certified milk" was originated by Dr. H. L. Coit and was registered in the U. S. Patent Office in 1904. In 1923, the American Association of Medical Milk Commissions published their revised "Methods and Standards for the Production and Distribution of Certified Milk."[12]

The following standards have been adopted by the United States Secretary of Agriculture:

1. Milk is the whole, fresh, clean, lacteal secretion obtained by the complete milking of one or more healthy cows, properly fed and kept, excluding that obtained within fifteen days before and five days after calving, or such longer period as may be necessary to render the milk practically colostrum free.

2. Pasteurized milk is milk that has been subjected to a temperature not lower than 145 degrees Fahrenheit for not less than thirty minutes, after which it is promptly cooled 50 degrees Fahrenheit, or lower.

3. Homogenized milk is milk that has been mechanically treated in such a manner as to alter its physical properties with particular reference to the condition and appearance of the fat globules.

4. Skimmed milk is milk from which substantially all the milk fat has been removed.

5. Buttermilk is the product that remains when fat is removed from milk or cream, sweet or sour, in the process of churning. It contains not less than 8.5 per cent of milk solids not fat.

6. Goat's milk, ewe's milk, etc., are the fresh, clean lacteal secretions, free from colostrum, obtained by the complete milking of healthy animals other than cows, properly fed and kept, and conform in name to the species of animal from which they are obtained.

7. Evaporated milk is the product resulting from the evaporation of a considerable portion of the water from milk, or from milk with adjustment, if necessary, of the ratio of fat to nonfat solids by the addition of or by the abstraction of cream. It contains not less than 7.8 per cent of milk fat, nor less than 25.5 per cent of total milk solids; provided, however, that the sum of the percentages of milk fat and total milk solids be not less than 33.7 per cent.

8. Sweetened condensed milk is the product resulting from the evaporation of a considerable portion of the water from the whole, fresh, clean lacteal secretion obtained by the complete milking of one or more healthy cows, properly fed and kept, excluding that obtained within fifteen days before and ten days after calving, to which sugar (sucrose) has been added. It contains not less than 28 per cent of total milk solids, and not less than 8 per cent of milk fat.

9. Evaporated skimmed milk is the product resulting from the evaporation of a considerable portion of the water from skimmed milk, and contains not less than 20 per cent of milk solids.

10. Sweetened condensed skimmed milk is the product resulting from the evaporation of a considerable portion of the water from skimmed milk to which sugar (sucrose) has been added. It contains not less than 24 per cent of milk solids.

11. Dried milk is the product resulting from the removal of water from milk, and contains not less than 26 per cent of milk fat, and not more than 5 per cent of moisture.

12. Dried skimmed milk is the product resulting from the removal of water from skimmed milk, and contains not more than 5 per cent of moisture.

PASTEURIZATION

Raw milk, if secured in a clean manner from healthy cows, is fairly safe in a small community or on the farm where it is consumed soon after it is obtained. But in our complex civilization milk must be transported long distances and kept over considerable periods of time before it reaches the consumer, and during this period of transport and storage the contained bacteria are likely to multiply enormously. Therefore anything which will kill these bacteria at the outset is helpful in rendering milk safe. This is what pasteurization does. In this process milk is held for thirty minutes at a temperature of from 142° to 145° F., and is cooled immediately thereafter. This kills those pathogenic organisms which might be present, and increases the keeping qualities of the milk.

It should be understood that pasteurization is not intended to take the place of rigid sanitary control over the methods of production; it merely is an adjunct to this control. Dirty milk cannot be rendered clean by pasteurization, but relatively clean milk can by this process be rendered safe. The label "Pasteurized" on commercially produced milk should be limited by law to unadulterated milk which has been hygienically obtained, carefully handled and then pasteurized.

It should be emphasized that milk which has been pasteurized should be kept cool and should be used within a reasonable time, say thirty-six hours. Old pasteurized milk improperly handled can be dangerous.

The heat to which milk is subjected during pasteurization destroys some of the vitamins, notably vitamin C, and causes minor chemical changes. Except for this vitamin destruction, it does not appreciably influence the nutritive qualities of the milk, and even this does not detract from the value of the milk if orange juice, tomato juice or other substances rich in vitamins are added to the dietary.

There is no conflict between the value and uses of "certified milk" and of "pasteurized milk." The president of a large certified milk producer's association recently said:[13]

> Pasteurization has undoubtedly accomplished more for the dairy industry, and therefore for mankind, than any other one thing that has been developed in connection with milk in recent years; and it is the only known way by which the great cities of the world can have a practically safe and ample supply of this cheapest and best of foods. Moreover, when it is known beyond preadventure that pasteurizing does not unfavorably modify any of the now known or still to be discovered attributes of milk, then by all means add this precaution to certified milk.

In large communities the necessity for pasteurization of milk is real. Not only are milk-borne epidemics such as typhoid fever and malignant sore throat prevented, but, what is of equal importance, the intestinal diseases of infants are in a large measure guarded against. For several years the board of education of the city of Birmingham, Ala., has permitted only pasteurized milk to be served with the lunches provided at the school.

BUTTER

Butter contains the fat of the milk in semisolid form. The emulsified fat droplets of soured milk or cream coalesce in the process of churning to form butter, in which is included also small amounts of casein and other milk components. These droplets are surrounded each by a viscous membrane which normally maintains with the surrounding fluid a certain equilibrium of tension; the foam which results from churning upsets this equilibrium, and union of the droplets occurs. The resulting lumps of butter which rise to the top are skimmed off, worked together into a homogeneous mass and washed. In the washing much of the casein, salts and other substances are removed.

Good dairy butter contains about 90 per cent of fat, 8 per cent of water and 2 per cent of salt, casein, lactose and other substances. The amount of casein and milk sugar in well washed butter is small; the smaller the amount of the former, the better the keeping qualities of the butter.

Fresh butter has a pleasant, aromatic odor which improves during the first few days of cold storage. This attractive odor and flavor are due in part to lactic acid and also to certain other aromatic substances. Its normal yellow color is dependent in large measure on the food of the cow; in the spring this color is deeper. It is the custom to add a little coloring matter in making butter.

After a time, through the liberation of certain lower fatty acids, butter tends to become rancid. Salt is added ordinarily to freshly churned butter with the object of retarding its deterioration. The value of this addition, however, has been questioned. Many investigators state that a small quantity of salt, not in excess of 2 per cent, improves the keeping qualities of the butter. On the other hand, Dahlberg, on the basis of his experiments, states that unsalted butter keeps best, and that salt hastens the appearance of the fishy flavor which old butter acquires. He says: "Salt, exclusive of its antiseptic qualities, hastens the deterioration of butter."[14] The literature is full of contradictions. It can be said with certainty, however, that fresh unsalted butter is more attractive and possesses the fine flavor of good butter to a higher degree than does the salted product; and that if salt is added, it should be in small amounts. Anyone who has grown accustomed to unsalted butter will always prefer it.

The manufacture of butter has become a fine art. The effort today is to obtain a product of high purity and good keeping qualities, and one which also has a pleasant flavor. It has been learned that the flavor of butter can be improved by innoculating the milk with certain bacterial cultures as "starters;" these contain strains of several organisms, the combined action of which is necessary for best results. A good "starter" produces a flavor which continues to improve for one or two weeks.

Butter offers the most easily digested form of fat. It is eaten not only for its taste and flavor, but for its high fuel value. As it consists almost entirely of fat, its caloric value is higher than that of any other food. It is probably more universally eaten than any other food.

FERMENTED MILK

From time immemorial pastoral races have fermented the milk of their herds in order to preserve it and keep it palatable. Usually this results in lactic acid formation; sometimes in alcoholic fermentation. The fat remains unchanged; the curd is broken into finely divided particles which are perhaps more digestible than that which forms in the stomach, and the milk sugar is converted largely into lactic acid or alcohol. Because of the aroma of the lactic acid and the nature of the curd, many people prefer such milk; invalids who do not easily retain milk are sometimes able to take the fermented varieties more comfortably than fresh milk.

The best known of these is buttermilk. It is the residue which remains in the churn after removal of the butter; it contains all of the constituents of milk except the fat. It is frequently made by inducing fermentation in whole or skim milk through the addition of cultures of lactic acid bacilli. Koumiss, Kefir, Matzoon, Yogurt, and similar fermentation products are made by the addition of certain strains of micro-organisms to mare's milk or cow's milk. The resulting fermentation imparts to the milk its peculiar sour flavor and other characters. Such milks have a pleasant flavor, and the invalid often finds in them a grateful substitute for the usual milk.

Bacillus Acidophilus Milk.—Similar to the fermented products just described is *Bacillus acidophilus* milk. Its importance is due to the fact that a radical change in the nature of the intestinal flora of man can be brought about by the introduction of *Bacillus acidophilus* in sufficient numbers. The putrefactive and other organisms which normally inhabit the intestinal tract in the adult largely disappear, and this freshly introduced organism comes to predominate to the extent of 85 or 90 per cent. It is a large gram-positive pleomorphic bacterium which resembles *Bacillus bulgaricus.*

The therapeutic value of *Bacillus acidophilus* has been demonstrated by Rettger and Cheplin,[15] who pointed out that milk culture is the best vehicle for introducing this organism into the intestinal tract. It grows readily in milk but dies quickly; there is considerable danger of cultural contamination with other bacteria which may easily outgrow it. Therefore the manufacture of this milk should be undertaken only with proper safeguards. For the inoculation of each new supply of milk a culture of known purity must be used; this fresh "starter" should come from a bacteriologic laboratory, not from the dairy or home.

The authors just quoted describe the manufacture of *Bacillus acidophilus* as follows:

> Fresh skimmed cow's milk is sterilized in one heating at 115–120° C., the time required being determined by the volume of the milk and the nature of the container. Quart lots in ordinary glass flasks are heated 22–24 minutes. Properly heated milk should have a dark cream color, but should not be distinctly browned. After cooling to at least 37° C. the milk is inoculated with pure strains of B. acidophilus which have been grown, by repeated transfers, sufficiently long in milk to develop rapidly and bring about coagulation of the casein within twenty-four hours at a temperature of from 35 to 37° C. Viable milk cultures of the organism are employed as the inoculum, and at least 10 cc. of the inoculum are transferred for each liter of milk treated. After thorough mixing, the newly inoculated milk is incubated for the period stated.

Many biologic laboratories have placed acidophilus milk on the market in packages of convenient size. It is dispensed usually in 7 ounce bottles, six to the package. This is a rather expensive way, however, of obtaining the large quantities of milk necessary for good therapeutic results. Many city dairies are also producing it under the control of nearby bacteriologic laboratories. In Birmingham, for instance, the manufacture of this milk is carefully controlled by bacteriologic laboratories at the University of Alabama under the direction of Professor Brooks. Such control must always be immediate and effective, and the laboratory must constantly furnish fresh cultures; else a contaminated worthless milk will be unavoidable.

For patients who do not have access to a nearby acidophilus milk supply or who cannot afford to depend solely on the milk shipped by biologic laboratories, I have formulated the following directions for making it in the home, which have given satisfactory results:

Request, the biologic laboratories of L— to ship you direct every two weeks a package of six bottles of *Bacillus acidophilus* milk. This is to be used as an inoculum for the milk which you are to make. Heat 2 quarts of skim milk in a double boiler the water of which is at boiling temperature thirty minutes; cool the milk to body temperature and then add one bottle of commercial acidophilus milk; place the milk in a fireless cooker, the stones of which must not be too warm to be held comfortably in the hand, for several minutes, and keep in a warm place for from twelve to twenty-four hours (at the end of ten or twelve hours it may be advisable again to warm the stones). Instead of the fireless cooker a Thermos jug may be used. After this the milk, when cooled, is ready for use. Cream may be added if desired. This gives a supply which when kept cool is sufficient for two days. The next supply must not be inoculated from homemade milk but from the commercial supply.

Properly made acidophilus milk has a pleasantly characteristic odor and flavor, somewhat similar to that of good buttermilk; it is not as acid, however, as the latter. It has a smooth, creamy consistency due to the finely divided curd; it is not lumpy, and even on standing, it preserves its creamy character. When other organisms predominate, as the result of poor sterilization or careless handling, the characteristics of the milk are different; it may have more of the taste and odor of sour milk with large lumps of curd, or it may have a distinctly putrefactive odor. When it is properly made, however, even those people who dislike ordinary buttermilk can learn to enjoy its refreshing taste if they are willing to do so. For a discussion of the potency of cultures and the various preparations of *Bacillus acidophilus* the reader is referred to a recent article by James.[15]

CANNED MILK

To preserve milk over long periods some method other than pasteurization must be adopted; for this purpose, various methods of canning have been devised:

Condensed Milk.—This is made by adding large quantities of cane sugar to fresh milk, heating for a short time at 180 or 200 F. to dissolve the sugar, then evaporating until the milk is two-fifths of the original volume and has a sugar content of about 40 per cent. It must contain at least 8 per cent of fat and 28 per cent of milk solids. In this process the milk is not completely sterilized, but the high sugar content prevents the multiplication of bacteria. Condensed milk in an unopened can will keep indefinitely. Its sugar concentration prevents freezing in winter, which gives it an advantage over evaporated milk.

Evaporated Milk.—This is made by evaporating fresh milk, without the addition of any ingredient, to about one-half or two-fifths its original volume. It is then placed in cans and heated by steam under pressure at a temperature sufficiently high to insure sterilization and to give the milk sufficient body to prevent the subsequent separation of the fat. It must contain not less than 7.8 per cent of butter fat and

25.5 per cent of total milk solids. When the proper processes have been employed evaporated milk is sterile and can be preserved indefinitely; but it must be used promptly after the can has been opened. Putrefaction in poorly made milk is easily recognized.

The heat to which the proteins and fats of evaporated milk have been subjected probably renders this milk more digestible than raw milk, but changes take place in the minerals which perhaps convert them into less utilizable forms. Evaporated milk can by the addition of water be reconstituted to approximately the same chemical composition as raw milk. It has the disadvantage that it freezes in very cold weather and that because of its bulk it is not as easily transported as milk powder.

Milk Powder.—This is made by several processes. There are two chief methods: the milk is dried in a very thin layer at a high temperature on a revolving drum and then reduced to powder; or, after condensation, it is sprayed in a very fine stream under pressure into a hot air chamber where the solids drop to the bottom as a fine powder. The temperature of the particular process by which the milk powder is made will determine its value to a certain extent; that which is made at the relatively lower temperatures can be more easily reconstituted in cold water and perhaps has other advantages.

Skimmed milk only was used at first; in this form the butter fat may again be added when the milk is reconstituted. These powders have been used extensively in the manufacture of ice cream and milk chocolate. Milk powders today are also made from whole milk and from half skim milk. Under the United States food and drug regulations, the former must contain not less than 26 per cent of milk fat and not more than 5 per cent of moisture.

To reconstitute whole milk so as to obtain a milk containing 3 or 4 per cent of fat, there should be added to one part of whole milk powder eight or eight and a half parts of water. The average percentage composition of the three forms of dried milk is given in Table 5. Table 1.

TABLE 5.—*Composition of Three Forms of Dried Milk**

	Average Percentage Composition				Caloric Value per Ounce
	Casein	Albumen	Sugar	Fat	
1. Full-cream milk	24.50	1.94	38.92	28.00	146 cal.
2. Half-cream milk	30.58	2.42	39.70	15.10	119 cal.
3. Separated milk	31.40	2.49	55.00	1.00	104 cal.

* This table is taken from Pritchard, quoted by Mendenhall, D. R.: Milk, U. S. Dept. of Labor, Children's Bureau, Bull. 35, p. 24.

It is essential that good clean milk be used. No ingredients are added in modern methods of making milk powder, and the milk can be reconstituted today from these powders without the addition of anything but water. The fat droplets are said to be reduced in size but to retain their globular form. The proteins are not coagulated or toughened in drying and are still soluble in water. It is said that when the best methods of manufacture are used, the growth promoting quality of milk is not appreciably diminished.[16]

The great advantage of milk powder is that if the contained moisture is within the standard prescribed, bacterial decomposition or fermentation will not take place. Formerly, whole milk powder became rancid after a time, but with improved methods it can be kept several months when the container has been opened, and even a year unopened, without taking on a rancid odor; it should be protected as far as possible from light and air. Mendenhall enumerates the good points of dry milk as follows: (1) increased digestibility, (2) bacterial purity, (3) keeping qualities (no ice needed), (4) convenience (always ready), (5) palatability, (6) cheapness (no waste), (7) small bulk—easy transportation—and (8) it does not freeze. This author reminds us that it is a canned food, however, which has been subjected to high temperatures, and that there is no definite guarantee as to the quality of the original milk used in the process. Notwithstanding the disadvantages, the many advantages of powdered milk would recommend for it a more extensive use than it receives today.

CHEESE

For centuries cheese has been a satisfactory medium for the preservation in palatable form of the nutritive elements of milk. It furnishes many races with a large part of their protein. In America, the making of cheese has become a successful industry, and its consumption is increasing.

Cheese contains all of the casein and some of the albumins and salts of the milk from which it comes; if made from whole milk, it also contains the fat. Its flavor, odor, consistency and appearance depend on the method of manufacture and the nature of the organisms concerned in its ripening. The following brief description of the methods of manufacture and the composition of various cheeses is taken largely from Sherman.[17] There are two main types: the hard varieties, such as American (Cheddar), Swiss (Emmenthal), Edam, Parmesan and Roquefort; and the soft varieties, such as Brie, Camembert, Neufchatel, Gorgonzola and Limburg.

American or Cheddar cheese is the variety largely produced in this country. Whole milk of good quality is used in its manufacture. The several stages through which the curd must go are: ripening of the milk; precipitation of the curd through the addition of rennet; the removal of the whey and the packing or "cheddarizing" of the curd; milling, salting and pressing of the curd; and then ripening for several weeks or months through storage at an appropriate temperature. The predominant organisms in this process of ripening are *Streptococcus lactis* and those of the lactobacillus group.

Edam cheese from Holland and pineapple cheese made in this country are both hard rennet cheeses from whole milk; both are artificially colored. Swiss or Emmenthal cheese belongs in the same class, but it is made from skim milk. Its characteristic flavor and the carbon dioxide gas which develops during ripening, with the resulting holes, are all due to the particular type of bacteria concerned.

Roquefort is a hard rennet cheese made from the milk of the goat. It acquires a marbled appearance through the development in it of *Pencillium*, its chief ripening agent. Parmesan is a hard cheese which is especially useful when grated cheese is desired; it has excellent keeping qualities.

Soft cream cheese, popular in this country, is made from soured cream or sweet cream thickened with rennet. It differs from other soft cheeses in having more fat and water and less protein. It is commonly sold in small tinfoil packages.

Camembert is a soft rennet cheese made from cow's milk. It has a thick rind, consisting in part of molds, and an interior of a soft, somewhat creamy consistency. Its characteristic odor and flavor are due to molds (*Oidium lactis*) and to the proteolytic ferments which digest the casein and thus incidentally give to the cheese a soft consistency. Brie is a soft cheese similar to Camembert. Neufchatel is a soft rennet cheese made from cow's milk, whole or skimmed. Gorgonzala is also a soft rennet cheese made from whole cow's milk; it has a mottled appearance and a characteristic odor due to the development of *Pencillium.* Limburg cheese owes its odor and taste to the development of putrefactive bacteria.

The Digestibility of Cheese.—The opinion is widespread that cheese is difficult to digest. Sherman believes that the discomfort which sometimes follows the eating of cheese may be due to the irritating effect of its volatile acids and protein split products, but he thinks that more blame can be placed on the unsuitable time at which this food is usually eaten: between meals, late at night and at the end of an already sufficient meal. Langworthy[18] reported studies which showed that a man in a calorimeter expended no more energy in digesting cheese than in digesting a corresponding amount of meat, and concluded that cheese does not differ materially in ease of digestion from a comparable amount of meat.

It is a little difficult to reconcile the opinions here expressed with the contrary view held by so many people. No doubt the physical character of hard cheese and its admixture with fat make digestion slow; this also explains why a considerable part of the digestion of this food takes place in the intestine. It has been suggested that the cooking of cheese may lead to the decomposition of the fats. But if cheese is eaten during the meal, as are other protein foods, and if it is thoroughly masticated, it need not be regarded as especially difficult to digest.

The Food Value of Cheese.—Cheese is highly nutritious. It is rich in protein, fat and mineral elements. The protein and fat of a pound of good cheese equals in amount that of a gallon of milk, and appreciably exceeds that of the same weight of the best steak. The protein is of high quality; it consists largely of casein which in the ripening process has been partially digested. About 69 per cent of the nitrogen of ripened cheese (six months) is in soluble form. The fat of the cheese is easily assimilated and differs but little in character from that of milk; its amount depends largely on whether whole or skim milk was used in the making. Cheese retains the calcium, phosphorus

TABLE 6.—*Approximate Average Composition of Different Types of Cheese** (*Sherman*)

Variety	Water, Per Cent	Fat, Per Cent	Protein (N × 6.25), Per Cent	Salt, Milk Sugar, Lactic Acid, and Ash, Per Cent
Brie	50	28	18	4
Camembert	45	30	20	5
Cheddar (American)	35	34	25	6
Edam	33	29	29	9
Emmental (Swiss)	34	31	30	5
Limburg	35	30	29	6
Neufchatel	50	27	18	5
Parmesan	35	21	36	8
Pineapple	24	38	30	8
Roquefort	35	32	25	8

* Based on analyses given in Bulletin 105, Bureau of Animal Industry, United States Department of Agriculture; quoted by Sherman, H. C.: Food Products, p. 122.

and sulphur of the milk and also appreciable amounts of iron and of vitamin A. It is a valuable article of diet.

To exhibit its full value, cheese should be given its proper place in the dietary. Since it is rich in both protein and fat, it should serve largely to replace these, not to supplement them as is so often the case. When cheese takes a prominent place in the diet the varieties with mild flavors, such as American cheese, should be eaten; the more highly flavored kinds should be taken in small amounts as a condiment at the end of the meal. A meal of bread, rolls or water crackers, with cheese and fruit, is well balanced and wholesome. To this there may profitably be added a crisp green vegetable, such as lettuce or celery.

Cheese is an economical food. At present prices the nutritive value, expressed in calories, of ten cents when expended for various articles of diet is: for beef, 467; for eggs, 198; for milk, 736, and for cheese, 886.

For a more complete discussion of cheese, the reader is referred to Sherman's book on "Food Products"[19] and to the bulletins of the United States Department of Agriculture.[20]

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CHAPTER VI

MEAT, FISH AND EGGS

MEATS

Meat is the edible portion of the animal. It includes the organs as well as the muscle meats; and the term properly applies to the food derived from poultry, game and fish, as well as to that derived from the animals ordinarily slaughtered for the market.

Meat is eaten because of its richness in good protein. It contains approximately 20 per cent of protein with a variable amount of fat and other substances and about 70 per cent of water. The muscle meats are consumed in vastly greater amounts than the organ meats, although the latter have certain points of superiority not possessed by the former. The chemical composition of the different cuts and of the organs will be found in a table of food values at the end of this book. For purposes of comparison, the average composition of the muscle meats ordinarily eaten and of the organs is shown in the following tables:[1]

TABLE 1.—*Chemical Composition of Some of the Commoner Meats* (*Atwater and Bryant*)

Meats	Water, Per Cent	Protein N. × 6.25, Per Cent	Fat, Per Cent	Ash, Per Cent	Fuel Value per Pound, Per Cent
Beef, lean round	70.0	21.3	7.9	1.1	730
Veal, breast	68.2	20.3	11.0	1.0	840
Lamb	63.9	19.2	16.5	1.1	1,055
Mutton	67.4	19.8	12.4	1.1	890
Pork, ham	60.0	25.0	14.4	1.3	1,075
Chicken	74.8	21.5	2.5	1.1	505
Fowls	63.7	19.3	16.3	1.0	1,045
Turkey	55.5	21.1	22.9	1.0	1,360
Fish, black bass	76.7	20.6	1.7	1.2	455
Clams	85.8	8.6	1.0	2.6	240
Oysters	86.9	6.2	1.2	2.0	235
Organs					
Beef					
Heart	62.6	16.0	20.4	1.0	1,160
Kidneys	76.7	16.6	4.8	1.2	520
Calf liver	71.2	20.4	4.5	1.6	605
Sweetbreads	70.9	16.8	12.1	1.6	825
Tongue	70.8	18.9	9.2	1.0	740
Veal					
Calf's liver	73.0	19.0	5.3	1.3	575

The *muscle meats* consist of protoplasm, connective tissue, fat, extractives and small amounts of sugar and mineral salts. Protoplasm is about three-fourths water and one-fourth protein; this protein is held both in solution and as an integral part of the cell structure. The proteins of meat furnish in liberal measure the amino-acids necessary for the construction of tissue, and therefore are of high biologic value. In this respect they are superior to vegetable proteins. The following table shows the amino-acids of beef:

TABLE 2.—*Amino-acids Obtained from Beef (Sherman)**

	Beef Protein, Per Cent
Glycine	2.06
Alanine	3.72
Valine	0.81
Leucine	11.65
Proline	5.82
Hydroxyproline	
Phenylalanine	3.15
Aspartic acid	4.51
Glutamic acid	15.49
Serine	
Tyrosine	2.20
Arginine	7.47
Histidine	1.76
Lysine	7.59
Ammonia	1.07
Tryptophan	Present
Summation	67.30

* This table is taken from Sherman, H. C.: Food Products, ed. 2, New York, The Macmillan Company, 1924, p. 234.

The amount of *connective tissue* is small, particularly in the younger animals and in the more desirable cuts.

The amount of *fat* depends largely on the nutritive state of the animal and therefore is variable. The manner in which it is deposited in the tissues varies with the kind of meat. In beef it is in distinct layers which can be separated from the lean meat. A part of this fat is removed by the butcher and still another portion by the cook, so that when the food actually reaches the table it contains as a rule less fat than the ordinarily accepted analyses indicate. In pork, however, the fat is deposited in minute amounts throughout the entire muscle, which explains the higher fat content of this meat.

Meat contains certain *extractives*. Chief among these is creatinine, which is present in lean meat to the extent of about 0.25 per cent. Purin bases are also present; these are much more abundant in the liver and other organs than in muscle. Glycogen also is found in small amounts. Meat is distinctly acid forming.

The *vitamin content* of muscle meat is low; it has been shown by Osborne and Mendel[2] that beef muscle contains very little of vitamins A, B and C. The same can be said of beef extract. Somewhat at variance with this is the result of Hoagland's[3] recent work; for he found that lean pork muscle and heart muscle contain a considerable amount of vitamin B. In planning the dietary, however, it is safest to credit no vitamins to the muscle meats.

Ash is present to the extent of about 1 per cent in lean meat; this is less in fat meat according to the extent to which the fat replaces protoplasm. The amounts of the various elements per hundred grams of protein found in the ash of average meat is given by Sherman[4] as follows:

TABLE 3.—*The Ash of Average Meat per Hundred Grams of Protein* (*Sherman*)

	Gm.
Calcium	0.05
Magnesium	0.12
Potassium	1.2
Sodium	0.3
Phosphorus	1.0
Chlorine	0.2
Sulphur	0.9
Iron	0.015

Most meats are tough and indigestible immediately after the animal is killed; but after a few days, the contained glycogen is converted into lactic acid, which in turn softens the connective tissues and renders the meat tender. For this reason, beef and other slaughter-house products are kept in cold storage, sometimes over long periods. If the meat is kept sufficiently cold, it improves for a time in flavor and eating qualities. That which has been frozen keeps much better than meat which has been stored at only 2 or 3 C.

The *organs* furnish more complete food than do the supporting and contractile tissues; they are superior both as to vitamin content and as to the quality of their proteins. This is ascribed by McCollum to their greater metabolic activity. McCollum and his associates[5] studied the nutritive value of the proteins of kidney, liver and muscle of ox in carefully planned feeding experiments on rats. They found that the kidney has the greatest nutritive value, that liver is second in value and muscle third. They consider the proteins of kidney, liver and milk as being most nutritional. The great value of liver as a blood building food was discovered by Whipple and Robscheit;[6]

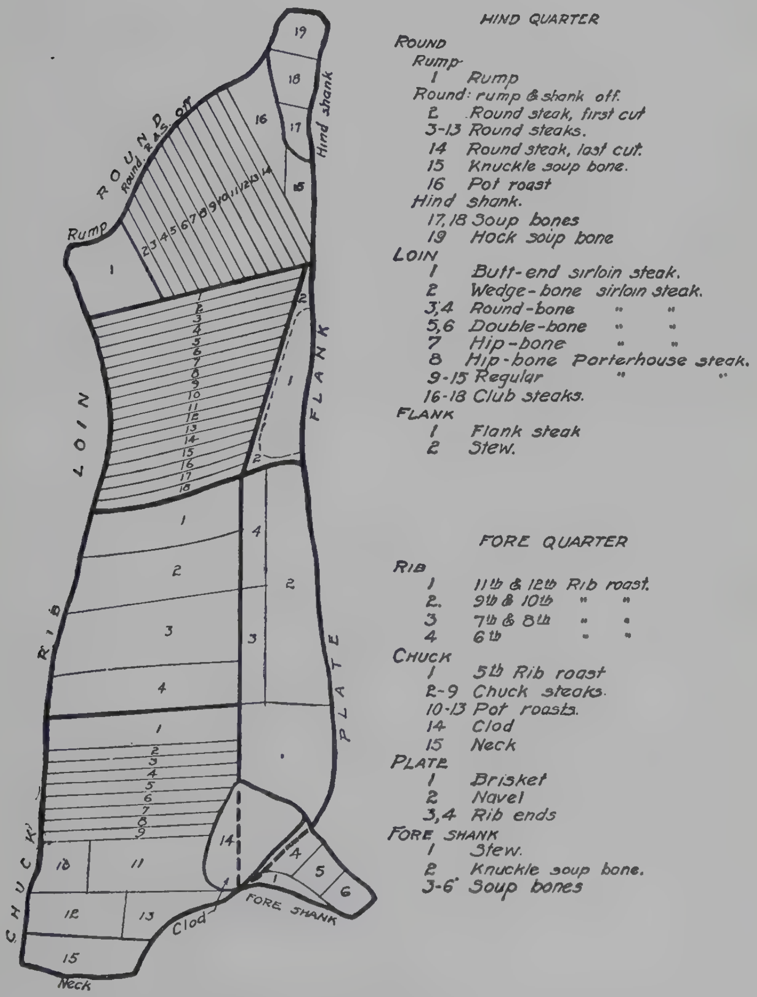

CHART 1.—Retail Cuts. (Taken from Hall, S. D., and Emmett, A. D.: Univ. of Ill. Agric. Exper. Station Bull. 158, 1912.)

this discovery was made use of by Minot and Murphy[7] in the diet devised by them for persons who have pernicious anemia. The superiority of the organs has seldom received adequate recognition.

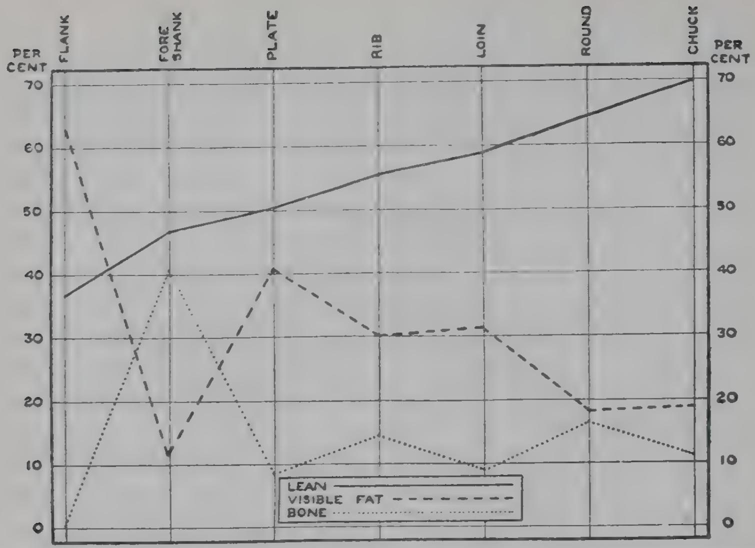

CHART 2. —Percentages of Lean, Visible Fat, and Bone in the Straight Wholesale Cuts. (Hall and Emmett.)

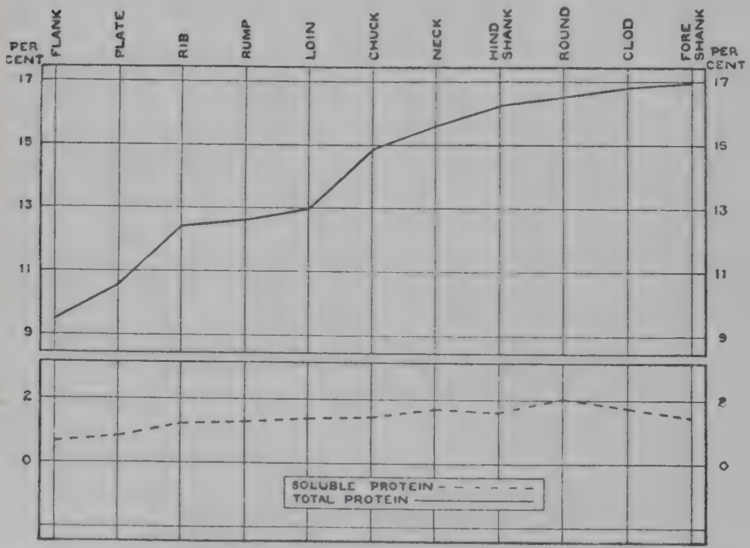

CHART 3.—Percentage of Total and Soluble Protein in the Boneless Meat of the Wholesale Cuts. (Hall and Emmett.)

TABLE 4.—*Percentages of Lean, Visible Fat, and Bone in the Retail Cuts**

Retail Loin Cuts	Lean	Fat	Bone	Total
1. Sirloin steak (butt-end)	70.46	23.32	5.67	99.45
2. Sirloin steak (wedge-bone)	69.82	23.27	6.40	99.49
3. Sirloin steak (round-bone)	65.71	28.17	5.37	99.25
4. Sirloin steak (round-bone)	61.43	29.18	8.94	99.55
5. Sirloin steak (double-bone)	59.01	26.55	13.84	99.40
6. Sirloin steak (double-bone)[1]	68.69	17.72	12.49	98.90
7. Sirloin steak (hip-bone)[2]	50.11	31.73	16.05	97.89
8. Porterhouse steak (hip-bone)	54.39	32.88	11.51	98.78
9. Porterhouse steak	53.78	39.22	5.80	98.80
10. Porterhouse steak	53.56	39.24	6.64	99.44
11. Porterhouse steak	59.41	32.93	5.46	98.80
12. Porterhouse steak	56.22	35.96	6.84	99.02
13. Porterhouse steak	55.49	35.41	8.23	99.13
14. Porterhouse steak	54.83	34.33	9.52	98.68
15. Porterhouse steak	50.04	41.44	7.77	99.25
16. Club steak	55.38	36.35	7.89	99.82
17. Club steak	55.33	32.93	12.80	99.06
18. Club steak	54.10	33.81	11.19	99.10
19. Trimmings (wholesale)[3]	9.79	90.21	0	100.00
Entire loin	58.53	31.75	8.89	99.17

Retail Rib Cuts	Lean	Fat	Bone	Total
1. Roast (eleventh and twelfth ribs)	49.44	37.74	12.41	99.59
2. Roast (ninth and tenth ribs)	54.26	31.41	13.97	99.64
3. Roast (seventh and eighth ribs)	56.00	27.81	15.79	99.60
4. Roast (sixth rib)	61.43	23.72	14.27	99.42
Entire rib	55.21	30.17	14.18	99.56

* This table is taken from Hall, S. D., and Emmett, A. D.: Univ. of Ill. Agric. Exper. Station Bull. 158, 1912, table 12.

TABLE 4.—*Percentages of Lean, Visible Fat, and Bone in the Retail Cuts** (*Continued*)

Retail Round Cuts	Lean	Fat	Bone	Total
1. Rump roast	48.62	31.13	19.81	99.57
2. Round steak (first cut)	74.16	13.57	11.25	98.99
3. Round steak	76.99	13.19	9.02	99.20
4. Round steak	84.47	9.71	5.13	99.31
5. Round steak	83.12	12.94	3.33	99.39
6. Round steak	81.84	14.36	2.64	98.84
7. Round steak	78.79	17.63	2.52	98.94
8. Round steak	77.53	19.61	2.62	99.76
9. Round steak[1]	81.85	15.93	2.22	100.00
10. Round steak[1]	78.15	19.33	2.52	100.00
11. Round steak[1]	74.90	21.96	3.14	100.00
12. Round steak	73.73	21.95	3.77	99.45
13. Round steak[1]	81.02	14.36	4.62	100.00
14. Round steak	75.05	16.63	7.31	98.99
15. Knuckle soup bone	19.00	21.78	58.36	99.14
16. Pot roast	85.43	13.38	0.87	99.68
17. Shank soup bone	40.13	11.37	47.62	99.12
18. Shank soup bone	66.72	12.35	20.19	99.46
19. Shank soup bone (hock)	8.08	10.36	80.86	99.30
Entire round	64.61	18.03	16.63	99.27

Retail Chuck Cuts	Lean	Fat	Bone	Total
1. Roast (5th rib)	64.07	20.78	14.65	99.50
2. Chuck steak	62.11	18.80	18.33	99.24
3. Chuck steak	66.26	22.29	10.94	99.49
4. Chuck steak	72.41	15.81	11.37	99.29
5. Chuck steak	69.91	16.60	12.50	99.01
6. Chuck steak	75.64	14.23	9.68	99.55
7. Chuck steak	82.10	6.41	10.78	99.29
8. Chuck steak	75.60	13.60	10.28	99.48
9. Chuck steak	74.76	14.57	9.85	99.18
10. Pot roast	75.89	14.44	8.89	99.22
11. Pot roast	58.45	26.53	13.94	98.92
12. Pot roast	78.06	9.07	12.66	99.79
13. Stew	60.79	33.86	5.03	99.68
14. Clod	80.39	14.62	4.69	99.70
15. Neck	60.47	22.12	16.48	99.07
Entire chuck	69.47	18.63	11.26	99.36

TABLE 4.—*Percentages of Lean, Visible Fat, and Bone in the Retail Cuts** (*Continued*)

Retail Plate Cuts	Lean	Fat	Bone	Total
1. Brisket	53.33	38.81	7.78	99.92
2. Navel	54.87	37.22	7.91	100.00
3. Rib ends	49.44	37.31	12.35	99.10
4. Rib ends	50.79	36.39	12.36	99.54
5. Wholesale trimmings	13.89	86.11	0	100.00
Entire plate	50.61	40.73	8.47	99.81

Retail Flank Cuts	Lean	Fat	Bone	Total
1. Stew	64.11	34.79	.58	99.48
2. Flank steak	83.05	16.44	0	99.49
3. Trimmings (wholesale)	.37	99.63	0	100.00
Entire flank	36.30	63.18	0.25	99.73

Retail Fore-shank Cuts	Lean	Fat	Bone	Total
1. Stew	82.58	17.10	0	99.68
2. Soup bone (knuckle)	29.38	11.12	58.68	99.18
3. Soup bone	28.03	10.98	60.23	99.24
4. Soup bone	39.88	13.14	46.61	99.62
5. Soup bone	68.88	5.68	25.16	99.72
6. Soup bone	17.43	6.51	79.94	98.88
Entire shank	47.61	11.63	40.20	99.44

KINDS OF MEAT AND THEIR PRESERVATION

Beef.—Beef is more commonly eaten in this country than any other meat. Perhaps this is because the beef industry is more highly developed, and the animals are fatter and better prepared for the market. Certain it is that in flavor and eating qualities no other meat sold in America is equal to good western beef. No other meat can be eaten as regularly day in and day out without tiring the appetite. In American restaurants beef is always the safest meat to order.

The slaughtering and marketing of beef has become an enormous business; the efficiency of the slaughter house methods by which the beef is killed, bled, skinned, dressed, quartered and refrigerated is almost a science. The weight of dressed beef is about 60 per cent that of the animal on the hoof.

Veal.—Veal is the meat of the calf. Since meat from young calves is tough and indigestible, it is required by law that the calf be at least

3 weeks old when slaughtered. Because of this belief that veal is not as digestible as other forms of meat, it is usually avoided by invalids.

Mutton and Lamb.—Mutton and lamb are desirable forms of meat, and in Europe are regarded as more delicate and more easily digested even than beef. The flavor of good mutton is said to resemble that of venison. The leg of the animal or "chops" taken from the ribs or elsewhere are the parts usually eaten.

Pork.—Pork is characterized by its high fat content and by the further fact that this fat is deposited between the individual fibers throughout the meat; it is not in separate layers as in beef. Therefore the fat must be eaten with the protein, which renders pork less easily digested by some people than other forms of meat. Well smoked ham, however, is tender and by many people is well borne. The pig is slaughtered in America with the same efficiency as the beef. Only about one tenth of the pork is eaten fresh, the remainder being preserved by salting and in other ways.

The **meat of poultry and game birds** does not differ in nutritive qualities from that of other meats. The supply of amino-acids and the vitamin and mineral content are essentially the same.

An effort has been made to distinguish between white and dark meats; the former are of looser texture with more nuclei; they also contain less connective tissue and less fat, and therefore are sometimes more easily digested. There is no difference, however, in the nutritive qualities of the two. The popular belief that the patient who must restrict his protein consumption can with impunity take white but not red meats is due to a gross misconception.

A great deal of the poultry sold today must be transported long distances, and the problems of food and water and of disease make the shipping of live poultry especially difficult. Dressed poultry, on the other hand, keeps well if the bird has been killed in the proper manner and all of the blood has been drained from the carcass. The flesh of freshly killed poultry is firm; the eyes are bright and do not have the dull, shrunken appearance sometimes seen; the feet are soft and pliable. It is of extreme importance that poultry be kept frozen during the period of transportation and storage; it would be better if it were delivered to the customer in the frozen state rather than first thawed out for display.

Game birds, such as quail, dove and wild duck, are scarcely to be considered here, since they are not sold in the market and form no appreciable part of the nation's food supply. When obtainable, they provide a welcome variation in the diet.

The Preservation of Meat.—The preservation of meat is undertaken in various ways: by cold storage, drying, smoking and canning.

Cold storage is the best method of preservation, for all meat improves for a time when kept sufficiently cold. Richardson and Scherubel,[8] in their studies on frozen meats, found that a thin layer of ice forms around the muscle fibers, which then become distorted and shrunken; they say that this layer presents an impenetrable barrier to bacteria. They found that beef which had been kept frozen as long as six hundred days was free from bacteria beyond a depth of 1 cm. but that meat which had merely been kept cold at a temperature of from 2° to 4° C. at the end of thirty days showed the presence of bacteria. Emphasis is placed on the difference in keeping qualities between meat which is actually frozen and that which is merely chilled.

These investigators found that frozen meat quickly dried to a depth of a few millimeters, but that after this it underwent no further appreciable physical or chemical change. The preservation of frozen meat over long periods interfered in no wise with its wholesomeness or its nutritive value.

In the *process of canning*, meat is first parboiled and, after removal of the fat, is preserved with some of the concentrated "soup liquor" in which it was boiled. Salt, sugar and other substances may be added to improve the flavor. This is usually labeled canned beef. If the meat is cured with salt and salt-peter before canning, it is called canned corn beef. The cheaper cuts of lean meat are usually used for this purpose. In these processes the meat loses a large part of its fat and extractives, but only about 1 per cent of the protein. If properly canned, it is nutritious and wholesome.

Smoking over a wood fire is a time honored process of preservation. This not only enhances the keeping qualities of the meat, but it softens the fiber and gives a certain desirable flavor which is difficult to imitate. The process is slow, and quicker methods are now in vogue, but there is no good substitute for properly smoked ham.

Preservatives, such as salt-peter, salt, sugar and vinegar are sometimes used. In addition to acting as a preservative, the first named substance deepens the red color of the meat, while the last three add to its flavor.

In *dry climates* meat is sometimes preserved by being cut in strips and hung out to dry. This is a slow process, and the resulting product is not as good as other forms of preserved meats. Such dried lean meat, mixed with fat, is the pemmican used by arctic explorers.

Meat extracts were originally believed to be highly nutritious, but it is now known that this is not true. Such products are mildly stimulating and pleasant to take, but they are practically without food value. Almost all of the contained nitrogen is in the form of extractives; chiefly creatine and purin bases. Such extracts were first prepared by Liebig and today are frequently called "Liebig's Extract."

The **inspection of all meats** intended for interstate commerce or for export is carried out rigidly by the United States Department of Agriculture. The object is to prevent the sale of meat obtained from diseased cattle or its contamination after slaughter. The carcass is easily infected; for instance, it has been shown that *Bacillus enteritidis* rapidly penetrates meat.[9] Such contamination may come from the hands of workers who happen to be carriers or from the fecal material of apparently healthy animals; epidemics of food poisoning have been traced to meat infected with this organism. In Birmingham, we recently traced a circumscribed but violent epidemic of food poisoning to meat which had been infected with an organism of the paratyphoid group.

The government's expert inspectors have access to every part of the slaughter house and examine the carcass of every animal. Diseased animals are immediately set aside and treated in such a way as to render them unfit for food. In order to reduce to a minimum the chance of contamination, the manner in which the meat is handled is rigidly controlled. The government also aids in the commercial grading of meats by setting up standards for classification. The sex, age and nutritive state of the animal determine the desirability of the meat, which accordingly is classed as: prime, choice, good, medium and common.

THE PLACE OF MEAT IN THE DIETARY

Meat takes a prominent place in the dietary because of its flavor, the stimulating influence of its extracts, and the high biologic value of its proteins. To insure normal growth for the child and continued vigor and longevity for the adult, a sufficient amount of protein is essential. This problem is discussed at length in another chapter, and the conclusion is there reached that 100 Gm. of protein, more or less, represents the optimum intake for the average adult. This can be secured most easily by including in the daily dietary a certain amount of meat.

The proteins of meat are surpassed in nutritive quality only by those of milk; they are equaled by the proteins of eggs. Milk and eggs have a distinct advantage over meat in respect to their vitamins and mineral content. To replace meat entirely with milk and eggs is compatible with good nutrition, and from a certain stand point, much might be gained thereby. Except among pastoral peoples, however, this rarely is feasible. Such a diet would lack the stimulating influence to appetite and digestion which comes from meat; also, the adult could not be depended on to drink enough milk to fully supply the requisite protein.

The superiority in food value of the organs, particularly of the kidney and liver, as regards vitamin content, blood building properties, and the high quality of their proteins, should again be emphasized. They are not ordinarily accorded the place in the dietary to which they are entitled.

Many people have scruples, usually unwarranted, against the eating of meat, and endeavor to secure their proteins largely from vegetables. The proteins of the cereal grains and vegetables, being deficient in certain amino-acids, are of low biologic value and cannot satisfactorily serve as the sole sources of protein. If the adherents to such a diet would supplement the vegetable proteins by taking a sufficient amount of milk, the diet would be right; otherwise it is faulty. The objections to a meat diet offered by vegetarians do not bear scrutiny. History does not indicate that the eating of meat has the debasing influence, physical or moral, feared by them. The most vigorous, intellectual and highly civilized peoples the world has known have eaten meat. One writer who contradicts the statement concerning the debasing influence of meat, calls attention to the fact that Moses, David, Solomon and Jesus ate meat.

It must be admitted, however, that in addition to its advantages, meat presents certain pronounced deficiencies. It is richer in purin bodies than other foods and therefore if eaten in large amounts may lead to an increased production of uric acid. It is also acid-forming in its tendency, which might under certain circumstances be a disadvantage. Its greatest deficiency is the lack of calcium and vitamins shown by the muscle meats.

A cogent objection to the diet which contains a large amount of meat is the likelihood that it may lead to putrefactive disturbances in the intestine. Almost all of the ills to which human flesh is heir have been ascribed at one time or another to this source. True, it has been clearly demonstrated that poisonous protein decomposition products arise in the intestine, but the extent to which this is a source of ill health or disease is another question; the body possesses certain effective lines of resistance to the entrance of these poisons. The subject has been well summarized by Alvarez,[10] who concludes that intestinal toxemia of protein origin as a potent cause of disease has as yet not been proved. Still, we can look on this possibility as a valid argument against the excessive eating of meat.

Meat is expensive and therefore is not an economical source of protein. Before the World War Americans consumed twice as much meat per capita as the continental Europeans, and one and a half times as much as the English. Sherman thinks that we could with advantage reduce our national meat ration to about half its present amount. In the average family budget, this would mean that the allowance for meat would be one-sixth of the total amount spent for food. Such a reduction in the nation's consumption of meat would perhaps be advantageous, if there would be a proportionate increase in the consumption of milk and milk products. There seems to be a definite tendency toward such a readjustment.

Summary.—The excessive consumption of meat often restricts the eating of other necessary foods and in other ways is probably harmful. To insure, however, an adequate intake of protein of good quality there should be included in the dietary approximately one serving of meat (or fish) each day. The organs, particularly liver and kidney, can with advantage occasionally be substituted for muscle meats.

FISH

Fish does not differ materially from other forms of meat. It contains more collagen and thus yields more gelatin than does meat and has less extractives and less hemoglobin. Its proteins, however, are fully equal in nutritive value to those of other animals. It usually contains less fat and more water.

The fat content largely determines the digestibility of the particular fish, those with the smallest amount of fat being more easily digested. In respect to their fat content, fish can be divided into three classes:[11] those containing 5 per cent or more; those containing between 2 and 5 per cent and those containing less than 2 per cent. Table 5 gives the chemical composition of the edible portion of some of the commoner fish. Complete tables will be found at the end of the book.

The character of the stream or other body of water from which the fish comes influences somewhat its flavor but not necessarily its nutritive value. There is no difference in the food qualities of fresh and salt water fish, preferences for the one or the other being purely individual. As a rule, the fish that come from clear, cold waters are more highly prized; sandy, rocky streams yield a more desirable catch than those with mud bottoms. Fish that prey on smaller fish and *Crustacea* are to be preferred to those which subsist on sewage and similar material.

TABLE 5.—*Chemical Composition of Some of the Commoner Fish* (*Atwater & Bryant*)

Fish	Water, Per Cent.	Protein N × 16.25, Per Cent.	Fat, Per Cent.	Ash, Per Cent.	Fuel Value per Pound, Per Cent
Fish, Fresh					
Bass, black, whole	76.7	20.6	1.7	1.2	455
Bluefish, entrails removed	40.3	10.0	.6	.7	210
Cod, whole	82.6	16.5	.4	1.2	325
Eels, salt water, hard, skin, and entrails removed	71.6	18.6	9.1	1.0	730
Haddock, entrails removed	81.7	17.2	.3	1.2	335
Mackerel, whole	73.4	18.7	7.1	1.2	645
Perch, white, whole	75.7	19.3	4.0	1.2	530
Pompano, whole	72.8	18.8	7.5	1.0	665
Salmon, whole	64.6	22.0	12.8	1.4	950
Shad, whole	70.6	18.8	9.5	1.3	750
Spanish mackerel, whole	44.5	14.1	6.2	1.0	525
Trout, brook, whole	77.8	19.2	2.1	1.2	445
Oysters in shell	86.9	6.2	1.2	2.0	235
Clams, long, in shell	85.8	8.6	1.0	2.6	240

Preservation.—Fish spoil quickly. This is due largely to bacterial invasion, but ferments also develop an unpleasant flavor which destroys palatability. For preservation or transportation to market, fish should be frozen, dried, salted or canned. A temperature of 32° F. will retard bacterial development, but it is not sufficiently low to prevent ferment action; to insure good preservation, fish should be kept at from 25° to 30° F. At such temperatures they will keep indefinitely. They should be cooked and eaten, however, immediately on thawing.

The *drying* of fish in Norway is done in the open air, but in this country the process of curing is more complex; salt is made use of in large amounts both as a preservative and as a dehydrating agent. In drying the salt cod at Gloucester, the fish is salted in the boat as soon as caught, then it is placed in a salt butt at the factory, after which further water is removed by pressure and by drying in the air.

The *canning* of fish has become a great industry. Many different kinds of canned fish are found on the market, the largest in amount being sardines and salmon. The sardines which come from France packed in olive oil are superior in flavor, but the American product is more economical and is just as good a food. The American sardines are salted, cooked and packed in cottonseed oil. In the canning of salmon, the fish is cut into pieces, placed in the can and then salted and heated. The heating completely sterilizes the contents of the can. The salmon canning industry is rigidly controlled by the United States Government, and a clean, high-grade product is assured.

Oysters and other shell fish are excellent food and are eaten extensively; the oyster industry has become a very large one. Oysters resemble in composition other forms of fish or meat, except that they contain a larger amount of carbohydrate. After removal from salt water, oysters are usually "fattened" by being placed for forty-eight hours in fresh or brackish water. They become larger and improve in flavor during this process, but it is doubtful whether there is an actual increase in the contained nutritive material.

The studies of Sherman on the ash of the oyster show that in calcium content it ranks above meat and below milk. It contains the other mineral elements in fair amounts. It is acid forming.

Clams, crabs, lobsters and shrimp are similar to oysters in eating qualities and also in the rapidity with which they deteriorate. Many people exhibit idiosyncrasies toward them; this is sometimes due to decomposition products in shell-fish which are not thoroughly fresh.

The **contamination of oysters** with disease-producing bacteria is a real menace; numerous epidemics of typhoid fever have been traced to this source. If the water in which the oyster grows is contaminated with sewage, germs are taken into the shell and the oyster becomes infected. The fresh water in which the oyster is "fattened" is a prolific source of such contamination. It has been stated that cooking does not remove this danger, since shell fish are seldom cooked sufficiently long to sterilize them. The oyster industry is subjected to ever increasing governmental vigilance, which is gradually making this danger more remote.

Digestibility.—The digestibility of fish and shell fish, meaning the completeness with which the contained proteins and fats are utilized, is about the same as that of beef and other meats. In ease of digestion and rapidity with which it leaves the stomach, oysters and lean fish rank with poultry and lean beef; fat fish, lobsters and crabs rank with other fat meats, such as goose and pork.

The **nutritive value** of the protein and fat of fish is the same as that of other meats. The recently demonstrated richness of fish oils in vitamin D, however, gives to this food a certain distinction and justifies for it a specific place in the dietary. The same can be said of its liberal supply of iodine. In shell fish, such as oysters and clams, we eat the entire animal (except the shell), including the organs of active metabolism, and thus secure vitamins not found in muscle meats. Fish and shell fish are used today as supplementary foods; they can, however, adequately serve as the sole source of protein, as has been demonstrated abundantly by other peoples. They always form a profitable addition to the diet.

EGGS

The egg furnishes all of the nutritive substances necessary for the complete development of the young chick, from which we must conclude that it contains a wide range of such substances. The average composition of the edible portion of eggs from different fowls is given in table six taken from Sherman.[12] The discussion which follows will concern hen's eggs only, since the other varieties are seldom used.

TABLE 6.—*Average Composition of Eggs (Langworthy)*

Description	Water, Percentage	Protein, Percentage	Fat, Percentage	Ash, Percentage	Fuel Value per Pound, Calories
Hen:					
Whole egg, edible portion	73.7	13.4	10.5	1.0	672
White	86.2	12.3	0.2	0.6	231
Yolk	49.5	15.7	33.3	1.1	1643
Duck:					
Whole egg, edible portion	70.5	13.3	14.5	1.0	835
White	87.0	11.1	0.03	0.8	203
Yolk	45.8	16.8	36.2	1.2	1683
Goose:					
Whole egg, edible portion	69.5	13.8	14.4	1.0	829
White	86.3	11.6	0.02	0.8	211
Yolk	44.1	17.3	36.2	1.3	1793
Turkey:					
Whole egg, edible portion	73.7	13.4	11.2	0.9	700
White	86.7	11.5	0.03	0.8	210
Yolk	48.3	17.4	32.9	1.2	1660
Guinea fowl:					
Whole egg, edible portion	72.8	13.5	12.0	0.9	735
White	86.6	11.6	0.03	0.8	212
Yolk	49.7	16.7	31.8	1.2	1598
Plover:					
Whole egg, edible portion	74.4	10.7	11.7	1.0	662
Fresh water turtle eggs	65.0	18.1	11.1	2.9	772
Sea turtle eggs	76.4	18.8	9.8	0.4	742
Salted duck eggs	68.0	12.0	9.2	4.0	594

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[12]

The average egg weighs from 50 to 60 Gm., of which about 12 per cent is represented by the shell. The edible portion is about 75 per cent water, 13 per cent protein and 12 per cent fat; or more roughly still, three-fourths water, one-eighth fat and one-eighth protein. By weight, the edible portion is about one-third yolk and two-thirds white. The food of the fowl determines to a slight extent the composition of the egg, particularly as to its richness in vitamins and minerals, and the character of its fats. The yellow color of the yolk is due to a certain carotin like pigment called entein. In Table 7 is given the percentage composition of the white and yolk of the egg:

Table 7.—*Comparison of White and Yolk of Egg** (*Sherman*)[13]

Constituent	White	Yolk
Water, per cent	86.2	49.5
Protein, per cent	12.3	15.7
Fat, per cent	0.2	33.3
Ash, per cent	0.6	1.1
Calcium, per cent	0.01	0.14
Magnesium, per cent	0.01	0.01
Potassium, per cent	0.16	0.11
Sodium, per cent	0.16	0.07
Phosphorus, per cent	0.01	0.43
Chlorine, per cent	0.15	0.1
Sulphur, per cent	0.196	0.157
Iron, per cent	0.0001	0.0085
Weight per average egg, grams	33	17
Weight per average egg, ounces	1.2	0.6
Fuel value per average egg, calories	17	60

* The occasional small discrepancies between the data for the entire egg and the sum of the data for white and yolk are due to the fact that the two sets of analyses did not cover exactly the same samples.

The *proteins* of the egg are of the highest quality. There are two chief proteins, ovalbumen of the white and ovavitellin of the yolk. These two differ in structure and in amino-acid content. In addition to ovalbumen, egg white contains in small amounts three other proteins, conalbumen, ovomucin and ovomucoid. Ovovitellin is a phosphoprotein which is closely related to casein, and probably exists in the yolk in combination with lecithin.

The *fat* of the egg, which is contained virtually all in the yolk, is in a finely emulsified form. A part exists as phosphorized fats, of which lecithin is an example. A salient characteristic of egg fat, like that of milk, is its ease of assimilation. Sherman quotes an experiment by

Volhard which indicated that 78 per cent of the fat of the egg can be digested in the stomach.

Vitamins A, B and D are present in eggs. The yolk is rich in vitamin A. It also contains an appreciable although not a large amount of vitamin B.[14] It evidently contains a liberal amount of vitamin D, for Hess[15] has recently shown that egg yolk has marked antirachitic properties. Egg yolk is much richer in these substances even than milk. The content of the egg in vitamin C is questionable.

The *mineral elements* of the egg are sufficient for the development of the chick and therefore should be suitable for the human body. Calcium, phosphorus and iron are found chiefly in the yolk. The phosphorus is in large part in the form of phosphoproteins and phosphorized fats and in combination with protein. The iron is in large part combined with protein; a compound of this character called hematogen has been described as the precursor of hemoglobin. Eggs also contain a large amount of sulphur which on oxidation yields sulphuric acid; this places eggs in the class of "acid-forming" foods.

The *digestibility* of the egg is good. In this respect the fat equals that of milk, being superior to most other forms of fat; the proteins also are easily and almost completely (approximately 98 per cent) utilized. The extent to which cooking influences the digestibility of the egg has been the subject of much investigation. Rose and McLeod[16] in their studies on human subjects concluded that the whites of eggs are well utilized whether taken in their natural raw state, beaten, or cooked. They find that the coefficient of digestibility increases slightly in the order named: 80 per cent for plain raw whites and 86 per cent for cooked whites, with a rate between these two for beaten egg. Hawk and his associates[17] found that while the method of cooking eggs influences the rate of digestion, it does not affect their total utilization. They find that hard boiled and soft boiled eggs call forth about the same degree of gastric response, but that the former are a little slower in leaving the stomach; scrambled eggs are still slower. Properly fried eggs are handled by the stomach as easily as scrambled or boiled eggs. It was found that eggs stimulate the stomach a little less and leave it a little sooner than meat.

Food Value of Eggs.—Their food value is high. True, the egg contains no carbohydrate,* but its proteins are of the best quality, it is rich in easily assimilable fats, and it is a valuable source of vitamins and mineral elements. Experiment has shown that as a suitable food for the growing animal, it ranks next to milk. For this reason and also because of its richness in iron, it serves as an excellent adjunct to milk in the diet of the child and of the adult who is recuperating from illness. Raw eggs are extensively used in the forced feeding of adults; because even in the absence of appetite, they can be swallowed in almost any quantity. The yolk is much more nutritious than the white. It carries the vitamins and a large part of the mineral elements, and gram for gram it furnishes about seven times as much energy. Although eggs vary considerably in size, it is customary to estimate 6 Gm. of protein and 6 Gm. of fat, or approximately 75 calories per egg.

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* Or a very small amount in the form of glycogen.

The Freshness of Eggs and Their Preservation.—Eggs, in order to avoid deterioration, like milk, require care in handling. The freshly laid egg possesses characteristics which can be recognized by a transmitted light, a process known as candling. These characteristics have been stated as follows:[18]

> Air Space: Not enlarged; less than three-fourths of an inch in diameter.
> White: Firm and clear.
> Yolk: Dimly seen through the white as a shadowy object indistinct in outline. The chick spot is not visible.
> Distinguishing Characteristics: No shrinkage and general firm condition of white and yolk. The yolk of such an egg is stiff and well rounded; the white is not watery, and it whips well.

The egg which is not fresh shows a larger air space; the white is thin and clear; the yolk is more definite in outline and may occasionally show mottled areas.

The quality of freshness in an egg is not solely dependent on age. Eggs which are laid in clean nests, gathered promptly, handled carefully, and kept cold, remain fresh much longer than other eggs. Delay in marketing and poor handling, including storage at improper temperatures, is said to cause the loss of about 8 per cent of market eggs and the unnecessary deterioration of a considerable part of the remainder. Eggs may be kept fresh in the home for several weeks by immersion in a solution of water-glass and preservation in a cool place. This solution is made by diluting ten times with water the commercial concentrated solution of sodium silicate. Only clean eggs of known freshness should be used.

Eggs are satisfactorily *preserved* in large numbers and for long periods in cold storage at a temperature just above their freezing point, from 29 to 32 F. To prevent the development of molds, the atmosphere must be dry, which has the disadvantage of causing a certain amount of drying out of the egg. During such storage the air space becomes larger, the yolk absorbs water from the white and becomes larger, and the white tends to adhere to the shell membrane and to precipitate minute crystals. These changes, even the breaking of the yolk which sometimes occurs, do not interfere with the edibility of the egg. The prejudice against cold storage eggs is not entirely justified; clean eggs kept a long time in cold storage are thoroughly edible and are much preferable to so-called fresh eggs which have been poorly handled. It should be borne in mind that fresh eggs, even "yard eggs," are often much older than the consumer thinks.

The edible portions of the egg may be removed from the shell, mixed and preserved in the frozen state. It is said that the industry of freezing eggs is a growing one, and that large quantities are preserved in this manner. Second grade eggs and worse are often used for this purpose, and for this reason frozen eggs as a rule contain large numbers of organisms, particularly *B. coli.* If, on the other hand, the eggs so preserved are originally of good quality, and the processes of candling, breaking and freezing are properly done, the resulting product should be good.

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CHAPTER VII

OTHER FOODS

THE CEREAL GRAINS

The cereal grains furnish the bulk of the world's food supply. This is because the improvement of the plough, the invention of other implements of agriculture, and the development of transportation have led in recent years to a great increase in grain consumption. The richness of the cereal grain in carbohydrate and protein, the facility with which it may be stored and transported, and the ease with which it is prepared for the table, all combine to make it our staple food. From an economical standpoint, too, there is good reason for the predominant place occupied by the cereal grains; for no other food furnishes an abundance of carbohydrate and protein so cheaply. It has been estimated that the average day's labor of one man on a wheat farm with modern implements produces enough food to meet the requirements of one person for a year.[1]

It should be emphasized, however, that in the form in which it reaches the market, grain is by no means a perfect food. The proteins are of relatively low biologic value, and the milled product is lacking in both mineral and vitamin content. These deficiencies can all be compensated for by the addition of milk.

In America wheat is the grain largely used; rye and barley come next in order of importance; then maize (Indian corn) and oats. Rice, however, is consumed in such enormous amounts in oriental countries that, taking the world as a whole, it must be regarded as the most important cereal grain.

Wheat.—The wheat kernel consists in large part (82 per cent) of endosperm, which consists of starch cells held in a fine reticulum of protein. Each cell contains innumerable starch granules of varying size. The endosperm is poor in mineral salts and does not contain vitamins. Surrounding this is the aleurone layer, which is rich in protein. At one end of the kernel is the germ, which constitutes about 5 per cent of the whole; it is rich in proteins of excellent quality, contains vitamins A, B and E, and also has an abundance of mineral elements. It also contains an oil. Surrounding the whole are several layers of bran; this is richer in ash than any other part of the kernel.

The proteins of the wheat are chiefly gliadin and glutenin, together known as gluten. They are of rather poor quality. One of the most important properties of these proteins is their "glutinous" quality; this quality is essential to good bread making, since without it an elastic dough and bread of the proper consistency cannot be obtained.

In the process of milling, the kernel is broken between successive rollers and goes through the "gradual reduction process." Sieves and other separating devices are placed between the several sets of rollers, and, by means of these, fractions of varying composition are obtained. The white flour of the endosperm, consisting almost solely of fine starch granules with very little gluten, comes through first. The so-called middlings, which come later, have a yellowish tint and contain more gluten. A mixture of these fractions in proper proportions constitutes high grade patent flour of commerce. This flour should have a slightly granular feel, but should not be coarse. It is of lighter color than the lower grade flours. Finely milled flour is greatly superior in keeping qualities to the whole grain. Thus it is seen that in the milling of high grade flours all of the germ and almost all of the bran are discarded. Because these discarded fractions contain all of the vitamins and much mineral matter, the milling is sometimes modified, and varying amounts of these portions are retained. Such flours have been given distinctive names, such as graham and whole wheat.

TABLE 1.—*Analyses of Wheat and the Products of Roller Milling (United States Department of Agriculture)**

Milling Product	Water, Per Cent	Protein (N × 5.7), Per Cent	Fat, Per Cent	Carbohydrate, Per Cent	Ash, Per Cent
First patent flour	10.55	11.08	1.15	76.85	0.37
Second patent flour	10.49	11.14	1.20	76.75	0.42
First clear grade flour	10.13	13.74	2.20	73.13	0.80
Straight or standard-patent flour	10.54	11.99	1.61	75.36	0.50
Second clear grade flour	10.08	15.03	3.77	69.37	1.75
"Red Dog" flour	9.17	18.98	7.00	61.37	3.48
Shorts	8.73	14.87	6.37	65.47	4.56
Bran	9.99	14.02	4.39	65.54	6.66
Entire wheat flour	10.81	12.26	2.24	73.67	1.02
Graham flour	8.61	12.65	2.44	74.58	1.72
Wheat ground in laboratory	8.50	12.65	2.36	74.69	1.80
Germ	8.73	27.24	11.23	48.09	4.71

* Quoted by Sherman, H. C.: Food Products, ed. 2, New York, The Macmillan Company, p. 302.

Graham flour contains the entire wheat kernel finely ground. Because of the large amount of bran thus retained it has valuable laxative properties, but for the same reason, it is more difficult to digest. Whole wheat flour has undergone a certain amount of reduction, which has removed a large part of the bran; but the germ with its protein, oil, vitamins and mineral matter has been retained. These bodies add greatly to the nutritive value of the flour.

The percentage composition of the various grades of flour which may be obtained in the process of milling as determined by the United States Department of Agriculture is seen in table 1.

Rice.—Rice, because of its great consumption in oriental countries, is more largely used than any other cereal; for half the human race it forms the chief article of diet. The grain can be obtained in the market in three forms: (*a*) unhulled, with the husk still adhering to the kernel, (*b*) cured without the husk but retaining the bran, and (*c*) polished, in which husk, germ and bran have all been removed. Polished (or white) rice is the form ordinarily eaten in this country, although brown rice is increasing in popularity because of its great nutritive value.

Rice is polished to enhance its keeping qualities, since the oil of the germ quickly becomes rancid; also because insects quickly attack the whole but not polished grain. This process, however, like the milling of flour, removes valuable constituents, notably vitamins and mineral elements. Polished rice is markedly deficient in respect to the quality of its proteins and the quantity of its minerals and vitamins. The discovery that a diet which consists solely of polished rice will produce beriberi gave an early incentive to the study of vitamins. Polished rice is practically devoid of all vitamins; but the disease in question is believed to be due specifically to the failure of vitamin B. The amount of phosphorus retained will give a fair index of the extent to which the polishing has removed both vitamins and ash; when rice

TABLE 2.—*Analyses of Rice* (*Sherman*)

	Unhulled Rice	"Cured" Rice	Polished Rice
Weight of 100 kernels, grams	2.929	2.466	2.132
Moisture, per cent	10.28	11.88	12.34
Protein, per cent	7.95	8.02	7.18
Fat, per cent	1.65	1.96	0.26
Fiber, per cent	10.42	0.93	0.40
Carbohydrates other than fiber, per cent	65 60	76.05	79.36
Ash, per cent	4.09	1.15	0.46

contains less than 0.4 per cent P_2O_5, nutritive failure will follow if rice is the sole food.[2]

Rye.—Rye is similar to wheat in composition and bread-making qualities, but the bread is much darker. That which is made from the whole grain, because of its greater cellulose content, is not so digestible as white bread or as that made of finely milled rye. Rye bread is extensively eaten in northern Europe.

Barley.—Barley is similar to wheat and rye in its nutritive properties, and contains an additional protein called hordein. "Pearl barley," which is the form in which this grain is largely eaten, is the milled product from which the germ and most of the bran have been removed. It is of value chiefly as an addition to soup. In finely powdered forms known as "patent barley" it is also used for the preparation of infant foods; barley water is a frequent diluent for milk.

Maize.—Maize, or Indian corn, is largely used for feeding cattle, but it is also an excellent food for man. Bread made from cornmeal has always been a staple article of diet in the southern states. The composition of corn is similar to that of the other grains, except that (like oats) it has a larger fat content. The hull is largely of wood fiber and gum. The endosperm consists of starch with some protein and very little fat and mineral matter. The germ contains proteins and is rich in oil and ash.

There are several grades of corn, each best suited to certain purposes. Field corn, which is permitted to dry before harvesting, is used for corn meal, hominy and cornstarch. Sweet corn is gathered while still green and is eaten as a vegetable.

Corn meal is used for making corn bread and for puddings; it will not undergo the leavening which wheat flour admits, and therefore does not make the same type of bread. Well made corn bread, however, is nutritious, easily digested and delicious. The "water ground" meal of our fathers was the best, because only the coarser particles were removed, and all of the germ with a portion of the bran was retained; it is seldom seen today, but the "old process" as it is called today makes a similar meal. Further milling with removal of all of the bran and germ makes a fine meal which contains less oil and therefore keeps better, but it is of distinctly lower nutritive value, and to those who are fond of corn bread it is not so palatable.

Corn starch is made by a process of grinding and sedimentation which permits the complete separation of the germ and of the bran. The starch of the endosperm is thus first separated and then it undergoes further purification.

Oats.—Oats are widely used as a breakfast food. In the preparation of rolled oats or oatmeal, only the chaffy husk is removed; the germ and bran are largely retained. This gives to such oat products a richer content in proteins, fat, vitamins and ash than is ordinarily obtained from the cereal grains.

Buckwheat.—Buckwheat is used largely in the making of pancakes. In the milling, a certain amount of the bran is retained. Well made "buckwheat cakes" eaten with syrup form a delightful breakfast dish, but it should be said that buckwheat preparations are not so digestible as similar dishes made from wheat flour or cornmeal.

Table 3 gives the chemical composition of these grains as determined by the United States Department of Agriculture.

TABLE 3.—*The Chemical Composition of Some of the Commoner Grains**

Grains	Water	Protein	Fat	Total Carbohydrates (Including Fiber)	Ash	Fuel Value per Pound
Barley meal and flour	11.9	10.5	2.2	72.8	2.6	1,640
Barley, pearled	11.5	8.5	1.1	77.8	1.1	1,650
Buckwheat flour	13.6	6.4	1.2	77.9	.9	1,620
Cornmeal, unbolted	11.6	8.4	4.7	74.0	1.3	1,730
Oatmeal	7.3	16.1	7.2	67.5	1.9	1,860
Oats, rolled	7.7	16.7	7.3	66.2	2.1	1,850
Rice, flaked	9.5	7.9	.4	81.9	.3	1,685
Rye flour	12.9	6.8	.9	78.7	.7	1,630
Rye meal	11.4	13.6	2.0	71.5	1.5	1,665
Wheat, spring	12.3	11.7	1.1	74.5	.4	1,650

* This table is taken from U. S. Dept. Agric., Bull. 28.

The Nutritive Value of Grains.—The cereal grains are closely allied in nutritive value. Such differences as exist depend largely on the structure of the proteins and the manner in which the grain is prepared. Roughly, the food value of an ounce (30 Gm.) of the milled grain approximates 100 calories. The value of the grains as they are prepared for human consumption is determined by: (*a*) the carbohydrate content, (*b*) the nature of the proteins and their amount, (*c*) the vitamins, (*d*) the mineral elements, and (*e*) certain other factors such as roughage and oil.

The carbohydrate of the grain is its chief nutritive constituent, and man's carbohydrate food the world over comes largely from this source. The carbohydrate contents of all grains are practically the same.

The proteins vary according to the nature of the grain. The amount and quality of the proteins in grain products depend somewhat on the extent to which the kernel has been milled. Many of the cereal proteins lack some essential amino-acid; hence they are of low biologic value. For instance, zein, the chief protein of corn is lacking in tryptophan, while gliadin of wheat and hordein of barley contain insufficient amounts of lysine. It should be said, however, that each of these grains contains other proteins as well, and that some have a tendency to make up for the deficiency of others. Wheat, rye, barley and oats are about of equal value in respect to their proteins. For a fuller discussion of this, see the reports of Osborne and Mendel.[3] It is appropriate to emphasize here the fact that milk proteins supplement the proteins of the cereal grains in an excellent manner.

Vitamin A is present in the cereal grains in only small amounts. Vitamin B is contained in abundance in the whole grain, but it is removed almost entirely in the process of milling. This explains the efficacy of brown rice in preventing beriberi. Cereal grains ordinarily contain practically no vitamin C, but when permitted to germinate they develop this vitamin. The whole grain contains vitamin E.

The mineral constituents of grain are held chiefly in the embryo and in the outer layers of the kernel. White wheat flour contains only about from one tenth to one fifth of the ash found in the whole grain. It is especially poor in calcium, iron, sodium, phosphorus and chlorine. The mineral deficiencies of the other grains is about the same, except that the oat has more calcium.

Among the *other substances*, the cellulose of the outer layers of the kernel is sometimes of value as a stimulant to peristalsis. The laxative effect of bran, however, is not due alone to cellulose, but also to some extent to the oil of the grain and perhaps to still other unknown laxative substances.

Whole wheat and similar flours have become very popular because of their superiority in protein, vitamin and mineral content, as well as because of their laxative properties. This popularity of whole wheat comes as a protest against our present-day faulty dietary habits. Such flours are of value, and their more widespread use is to be encouraged, but there are certain practical considerations which cannot be lost sight of. In the first place, whole wheat and graham flours are not so easily digested as the finer flours, and in persons of delicate digestion they may present an unnecessary burden. Then, too, the former are much inferior to the latter in keeping qualities. In our civilization it is necessary that grain products be transported great distances and kept for long periods of time; for this reason preparations made from the whole grain can never really take the place of the more highly milled flours. Whole wheat contains many needed nutrients which are signally lacking in white flour, but it is by no means a perfect food, and the semi-invalid cannot make up for all of his dietary and other faults merely by eating whole wheat bread. To eat the whole grain is a good practice, but the person who has been warned concerning the dangers of vitamin and mineral deficiencies may safely indulge himself in the enjoyment of white bread, provided he makes up for such deficiencies by taking a reasonable amount of the "protective" foods—milk, eggs and green vegetables.

Bread.—White bread is made of the leavened dough of wheat flour. This dough consists of a mixture of flour, water, lard (or other fat), sugar, salt and some leavening substance.

Two types of leavening agent are in general use, compressed yeast and baking powders. The former acts on the starch of the flour and the sugar, and produces carbon dioxide; this completely permeates the dough and gives it the desirable lightness. Baking powder, which consists of a mixture of alum or sodium bicarbonate with tartaric acid or acid phosphate, liberates the same gas with similar results when these agents come in contact with the water of the dough. Leavening is also accomplished by forcing water saturated with a gas into the dough, or by "beating" the dough in such a manner as to imprison in it small particles of air.

The mass is thoroughly kneaded, after which it is permitted to rise still further for a time, and it is then baked.

In the baking three important changes take place: the carbon dioxide contained in the dough undergoes further expansion and makes the bread still lighter; the proteins coagulate and "fix" the mass in a light spongy form; and the starch cells and granules burst. At the same time there is loss of water, and the starch on the surface undergoes caramelization and other changes which produce an attractive crust.

Wheat flour serves best for this purpose, because its gluten gives to the dough the proper elasticity. Rye approaches wheat in this respect more closely than the other grains, but rye bread is never really light. Rice, corn, oats or barley alone will not make this type of bread.

If the bread is baked in large masses, it is known as loaf bread; if in small pieces, as rolls. If milk (or milk solids in the proportions to form milk) are used to replace a part of the water of the dough, it is called milk bread. Because of the supplementary value of milk proteins, the addition of even this small amount of milk adds greatly to the nutritive value of the bread. Other forms of bread, such as corn bread or rye bread, are made by replacing wheat flour in part or in whole by other flours.

Biscuits, which are usually eaten hot, are made with baking powder and contain more fat than light bread. Muffins are lighter than biscuits; they usually contain egg, more milk and sometimes a little sugar. Crackers, sometimes called biscuits, are made from dough which has little or no leavening and which is rolled very thin before baking; they often contain more fat than bread, and occasionally are flavored or sweetened; they are particularly digestible because, being dry, they must be thoroughly masticated before they are swallowed.

When sugar, egg, spices, and other seasonings are added to the dough, it becomes cake; when there is a large amount of lard or butter, it is a pastry.

The fear of hot breads, such as rolls, biscuits and muffins, is probably not justified. If they are light and properly made and are slowly eaten, they are probably as digestible hot as cold.

Breakfast Cereals.—Almost all of the cereal grains have been prepared in some special form to be eaten as a breakfast food; they are usually taken with cream or milk.

In the process of manufacture, the grains have been subjected to various changes. Sometimes the kernel is merely husked and lightly "cracked," as in creacked wheat and Scotch oatmeal; at other times, it is finely ground and all of the outer layers removed, as in farina. In some, the grain is caused to pop open while being cooked under pressure, as in puffed rice or puffed wheat; or, after being partially cooked, it is flattened between rollers, as in rolled oats. In others, a dough made of the finely ground grain is pressed into flakes and baked, as in corn flakes. Sugar and other substances are sometimes added. Some cereal foods have been subjected to artificial digestion. Some are ready to eat; others must be cooked a long time. Their number is legion. Of them all, oatmeal and rolled oats are the best.

Unless something has been added, the nutritive value of the breakfast food is simply that of the grain, part or whole, from which it comes.

The advantage of such breakfast foods is not alone in their attractiveness and palatability, but chiefly in the necessity for taking milk or cream with them; for the proteins of milk supplement in a satisfactory manner those of the cereal grains. The disadvantage is in their cost; they are by no means economical. The puffed and flaked grains are very light and therefore carry relatively little nutrient for their bulk. Some breakfast foods in fancy packages cost fifteen cents for 5 ounces, while others cost only five cents a pound. These sold in bulk are obviously the most economical.

SUGARS AND SUGARY FOODS

Sucrose or cane sugar, a disaccharide, is the form in which sugar is largely eaten. Most fruits and fruit juices derive their sweetness from a mixture of this and certain of the simpler sugars such as glucose and fructose. The sugar of commerce is derived almost exclusively from the juice of the sugar cane and the sugar beet; by a process of refining, the sugar is permitted to crystallize out of the syrup and is brought to a high degree of purity and crystalline whiteness. Raw cane sugar and raw beet sugar show marked differences in flavor, owing to certain impurities which both carry; the former has a pleasant fragrance and taste, while the latter is bitter and disagreeable. The highly refined sugars, theoretically, should show no evidence of their origin; in fact, however, there are differences, for cane sugar carries with it some of the simpler sugars, the hexoses, while beet sugar does not.

Cane sugar on hydrolysis (as in cooking with dilute acids), is split into two hexoses, glucose (dextrose) and fructose (levulose). Under the influence of heat, it also has a tendency to undergo certain physico-chemical changes which result in caramel; this gives a darker color to its solution.

Glucose.—Glucose (dextrose, grape sugar) is a simple hexose which is found in fruits and fruit juices; it is abundant also in honey. The glucose of commerce is obtained largely by hydrolysis of corn syrup; it is often used for the adulteration of jams, syrups, etc., but the pure food laws require that such adulteration be stated on the label. Glucose has the same sweet taste as cane sugar and is equally nutritious. In fact, sucrose and all starches must be reduced by digestion to glucose or to a similar hexose before they can be utilized by the organism. Glucose is the form in which the carbohydrate of our food circulates in the blood.

Lactose.—This has the advantage of being less sweet than cane sugar, while possessing the same caloric value and the same ready assimilability. For this reason, larger quantities of lactose than of cane sugar can be given a patient.

Molasses.—Molasses is a syrupy liquid obtained from the juice of the sugar cane after some of the sucrose has been removed by crystallization. It is essential that the molasses be withdrawn at a relatively early stage in the process of sugar making ("first molasses"), for the syrupy liquid known as a "refiner's syrup" which remains at the end of the process contains very little sugar and, taken alone, is not an edible product. True molasses contains much of the sucrose as well as the ash and other constituents of the cane juice. It should contain not more than 25 per cent of water and 5 per cent of ash.[4]

Cane Syrup.—This is widely eaten in the South and is coming into still wider popularity; it is a very attractive, palatable product made from the juice of the cane by boiling in an open kettle until the proper consistency is obtained. All of the constituents of the original cane juices are retained, although some of the sucrose is split into simpler sugars.

Maple Syrup.—This is also a palatable syrup. It is made from the sap of the sugar maple, and the process of manufacture is similar to that of cane syrup.

Mixed Syrups.—Mixed syrups are usually made by the addition of glucose (from corn) to "refiner's syrup," a by-product of sugar manufacture, which contains all of the ash and other constituents but little of the sugar of cane syrup. It must be labeled as such. It is a good food but is not so highly prized as the other syrups.

Honey.—Honey contains a mixture of various sugars which have been obtained from flowers by the bee. It also contains—and this contributes greatly to its flavor—aromatic substances reminiscent of the flowers from which it comes. There is a detectable difference in the honey from different flowers. The chief sugars of honey are fructose and glucose, with a relatively small amount of sucrose. Attempts to imitate and adulterate honey are made with solutions of commercial glucose and other substances.

Preserves, Jams and Jellies.—Fruits are preserved by the addition of sugar. In preserves, the fruit usually retains something of its original form. Jams and marmalade are made by cooking fruits, with the addition of sugar, down to a soft mass; in this process much of the sucrose is split into simpler sugars. Jellies do not include the pulp, but usually contain merely the juice of the fruit which carries with it the sugars and certain other substances. Pectin, which is present in fruits before they are thoroughly ripe, helps the mass to "jell." In the manufacture of jellies, additional pectin is usually added. The food value of these products is due largely to the added sugar. Their attractiveness comes from the flavor of the fruit.

Candies.—As a rule, candies are made from sucrose, with the addition of other substances, such as chocolate and various flavoring extracts, as well as materials which give it the proper consistency. They are made also from glucose.

The Place of Sugar in the Diet.—The great value of sugar lies in the fact that it offers in a concentrated form the most readily available carbohydrate. Properly taken it throws little burden on the digestive organs and is quickly utilized. It is sometimes spoken of as a "stimulant;" in a sense we can say that it is the best stimulant we have, in that it gives to the body suitable material for the immediate renewal of energy. It has long been known that athletes have greater endurance if from time to time during the test of strength a little sugar is eaten; mountain climbers eat milk chocolate. It has been found recently that marathon runners show less exhaustion at the end if sugar is taken during the race. People who have been accustomed to sugar in the diet find it difficult to get along without it even when an abundance of other carbohydrate is available. I have seen American soldiers in France stand in line an hour or more in order to purchase a small box of candy. Sugar is of great value in feeding the sick when a readily assimilable carbohydrate is desired; this will be discussed with the subject of typhoid fever.

Another advantage possessed by sugar is its satiety value.[5] Experience has shown, and in this most of us will agree, that something sweet at the end of the meal gives an added sense of satisfaction. Even the obese who must curtail their food rigidly can make use of this fact; by adding a simple dessert to their heavy meal, they may get along with a smaller total intake and still enjoy a feeling of satisfaction.

On the other hand, the abuse of sugar has definite disadvantages. The ingestion of too much sucrose may result in the direct absorption of some of it and its excretion by the kidneys as a foreign body. Concentrated sugary masses in the stomach have a tendency to absorb water and thus cause irritation; the frequent eating of large quantities of sweets may lead to inflammation of the gastric mucosa. Sugars are slow to leave the stomach, and this retardation may result in fermentation with the production of irritating substances. The eating of an excessive amount of sweets causes the consumption of less of vegetables, fruits and other necessary foods. This sometimes leads to actual dietary deficiency. The addition of large quantities of sugar also disguises the natural flavor of the food and eventually blunts the finer tastes.

LEAFY VEGETABLES

The chief value of the leafy vegetable lies in its vitamin and mineral content. McCollum has called attention to the fact that in both vegetable and animal tissues the most actively functioning part possesses the vitamins. In this connection, this author calls attention to the difference in function between the leaf and the seed; the functional activity of the former is great, while the latter, being largely a storage organ, experiences little metabolic activity. The leaves which are thin and contain most chlorophyl are richest in vitamins. In cabbage or lettuce, for instance, the thin outer green leaves rank much higher in this respect than the inner leaves which are of lighter color. Green leaves are especially rich in vitamin A, and in this they rank next to milk. They also contain an abundance of vitamins B, C and E, although the latter is probably destroyed in large part in cooking. The leaf is richer, too, in mineral elements, especially in calcium and phosphorus, in which elements the diet is often lacking, for it contains from two to five times as much mineral matter as does the seed.

The other nutritive elements—carbohydrate, protein and fat—which the leaf offers are small in amount. While it contains considerable cellulose, the available carbohydrate is less than 5 per cent. The protein of the dried leaf varies; cabbage and the leaf of the turnip when dry contain a fairly good percentage of protein. It is said that the proteins of the leaf supplement to a certain extent those of the seed.

Spinach, lettuce, cabbage, turnip greens and beet greens are the leafy vegetables commonly eaten in America. Spinach is the most valuable of these. It is especially rich in vitamin A, containing as much of this factor even as butter or egg yolk; it also contains vitamins B and C in large amounts, being a valuable source of the latter. It is also rich in iron and other mineral elements. The green leaves of lettuce probably rank next to spinach. It should be borne in mind that bleached lettuce is probably not so valuable. Cabbage also comes just a little below spinach in its vitamin content. The green leaves of the beet and turnip have been less thoroughly studied than the others, but they apparently approximate cabbage and lettuce as sources of vitamins and mineral ash.

Cauliflower, while properly a flower, is usually classed with the leafy vegetables. It has similar properties.

The cooking of green vegetables destroys only in small part the vitamins A and B. Most vegetables, however, lose practically all of their vitamin C, particularly when cooked a long time. (This does not apply to the tomato.)

THE SEED VEGETABLES OR LEGUMES

Chief among these are beans and peas. These plants have the peculiar property of being able to utilize the nitrogen of the atmosphere for the synthesis of protein, and their value lies largely in their richness in protein. Whereas the cereal grains contain only about 10 or 12 per cent of protein, the legumes contain about 23 per cent. In their dry state, they possess pound for pound a greater amount of protein even than meat.

While the proteins of the legumes are of higher quality than those of the cereal grains, there is as a rule something lacking in their structure which limits their availability.[6] Many of them are lacking in cystine.[7] They have the power, however, to supplement in a satisfactory manner the cereal proteins; this is particularly true of wheat and the pea, and of wheat and the soy bean.

The legumes also are rich in carbohydrate and contain a small amount of fat. The large amount of hemicellulose in the bean often leads to intestinal fermentation and flatulence.

The vitamin content of the legumes varies somewhat; they are as a rule lacking in vitamin A; all contain an abundance of vitamin B. They offer a good supply of iron and phosphorus, but are usually deficient in calcium, sodium and chlorine.

The canning of peas and beans, especially the former, is an industry of increasing proportions. When properly canned, they form desirable food and constitute a staple article of diet.

ROOTS AND TUBERS

The **white potato** is one of the most staple foods. It consists approximately of three-fourths water and one-fourth nutritive substance; more accurately, it contains about 20 per cent carbohydrate, 2 per cent protein, 1 per cent ash and 77 per cent water. Its structure consists of a thin cork like peel within which may be distinguished three layers: an outer cortical layer of one-half inch or less in thickness, and two medullary layers, an outer and an inner. The outer medullary layer is the thicker and is the most important. The inner layer is irregular in outline and contains a larger percentage of cellulose. The medullary layers may be likened to the endosperm of the seed in that each serves merely as a storage organ. The carbohydrate of the potato is largely in the form of starch granules which is stored in cells; the walls of the latter are of cellulose. As the potato matures, much of its contained sugar is converted into starch; as it grows older the reverse takes place. Thus it is evident that there is more sugar in the very young and in the very old potatoes than in those which are recently matured.

Attempts have been made to show that the proteins of the potato are of especially high biologic value,[8] but animal experiment has not always confirmed this belief.

The great value of the white potato as a food lies in the fact that at a very low cost it furnishes an abundance of carbohydrate, with a small amount of readily assimilable protein, and that it is an excellent source of mineral elements. It is also a dependable though not a rich source of vitamins.

The **sweet potato** does not belong in the same botanical classification as the white potato, but as a food it presents similar properties. The chief difference is that it contains 5 per cent or more of sugar.

The **carrot** is of value chiefly because of its vitamin content. Like many other yellow pigmented food products, it is relatively rich in vitamin A. It also contains appreciable amounts of vitamin C.

The *beet* is of value chiefly because of its yield of sugar and the vitamin richness of its leaves.

The value of the *turnip* also lies in its antiscorbutic properties as well as in the vitamin content of the leaves.

STEMS AND BULBS

Celery is commonly eaten as a salad. The green leaves contain a fair amount of vitamins, but very little is known of the nutritive value of the stalk.

Asparagus also is eaten as a salad and little is known of its nutritive value. It contains an oil which has markedly diuretic effects, the possibly harmful influences of which in kidney disease should be considered.

Onions are very rich in vitamin C and also contain fair amounts of vitamin B; there is relatively little of vitamin A. To obtain the benefit of the vitamin C, however, they should be eaten raw. Onions, raw or cooked, are used to give flavor to other foods.

The **tomato,** although eaten as a vegetable, is in reality a fruit. Because of its richness in vitamins, its popularity is constantly increasing. Both raw and canned, it is equal to the green vegetables as sources of vitamins A and B, and to the citrus fruits as sources of vitamin C. The fact that the tomato retains its vitamin C even when canned makes it especially useful. Hess and others have shown that canned tomato juice can with impunity be given to very young infants, and that it will prevent scurvy.

TABLE 4.—*Average Chemical Composition of Some of the Commoner Vegetables**

	Water	Protein	Fat	Total Carbohydrates (Including Fiber)	Ash	Fuel Value per Pound
Asparagus, fresh	94.0	1.8	.2	3.3	.7	105
Beans, Lima, dried	10.4	18.1	1.5	65.9	4.1	1,625
Beans, Lima, fresh	68.5	7.1	.7	22.0	1.7	570
Beans, string, fresh	89.2	2.3	.3	7.4	.8	195
Beets, fresh	87.5	1.6	.1	9.7	1.1	215
Cabbage	91.5	1.6	.3	5.6	1.0	145
Carrots, fresh	88.2	1.1	.4	9.3	1.0	210
Cauliflower	92.3	1.8	.5	4.7	.7	140
Celery	94.5	1.1	.1	3.3	1.0	85
Corn, green	75.4	3.1	1.1	19.7	.7	470
Greens, dandelion	81.4	2.4	1.0	10.6	4.6	285
Lettuce	94.7	1.2	.3	2.9	.9	90
Onions	87.6	1.6	.3	9.9	.6	225
Peas, dried	9.5	24.6	1.0	62.0	2.9	1,655
Peas, green	74.6	7.0	.5	16.9	1.0	465
Potatoes, raw or fresh	78.3	2.2	.1	18.4	1.0	385
Potatoes, sweet, raw, fresh	69.0	1.8	.7	27.4	1.1	570
Pumpkins	93.1	1.0	.1	5.2	.6	120
Radishes	91.8	1.3	.1	5.8	1.0	135
Rhubarb	94.4	.6	.7	3.6	.7	105
Ruta-bagas	88.9	1.3	.2	8.5	1.1	190
Spinach, fresh	92.3	2.1	.3	3.2	2.1	110
Squash	88.3	1.4	.5	9.0	.8	215
Tomatoes	94.3	.9	.4	3.9	.5	105
Canned Vegetables						
Asparagus	94.4	1.5	.1	2.8	1.2	85
Beans, baked	68.9	6.9	2.5	19.6	2.1	600
Beans, string	93.7	1.1	.1	3.8	1.3	95
Peas, green	85.3	3.6	.2	9.8	1.1	255
Tomatoes	94.0	1.2	.2	4.0	.6	105

* This table is taken from U. S. Dept. Agric., Bull. 28.

FRUITS

Fruits are of value because of their laxative and base-forming properties and for their vitamins, as well as for their attractive flavor. Their caloric value, which is limited, depends largely on the amount of sugar which they contain.

The **apple** leads among the orchard fruits. It carries small amounts of vitamins A, B and C. It has definite laxative properties, probably owing to the large cellulose content. The young apple contains a large amount of starch, but as it ripens this is rapidly converted into sugar until when fully ripe it contains little or no starch. The acid content decreases as the sugar increases. In like manner its pectin, valuable in the formation of jelly, decreases with the ripening process.

The **citrus fruits** are next in importance to the apple, and their culture is being enormously increased. Oranges come first. They offer an excellent source of readily assimilable glucose, and for this reason orange juice is used when there is necessity for quickly assimilable carbohydrate which will throw the least burden on the digestive organs. Next in importance come lemons, grapefruit, limes and tangerines.

The chief value of citrus fruits lies in their antiscorbutic properties. All are especially rich in vitamin C. The orange, and, to a less extent, grapefruit contain both vitamin A and B; the others only vitamin B. Orange juice is given infants and children almost as a routine for the prevention of scurvy.

The base-forming properties of these fruits is important. Their acids do not increase the acidity of the body; in fact, the reverse is true. The acid salts of the organic acids, such as potassium citrate, which are found in fruits, lose the acid radicle by oxidation, and there is left merely the alkali carbonate with its base-forming properties. Therefore, contrary to popular belief, the acid fruits, such as the orange, lemon and lime, are base-forming and not acid in their tendencies.

Peaches, pears, plums, prunes, cherries and apricots all present in a greater or less degree the same laxative, antiscorbutic and base-forming properties of other fruits.

The **banana** has not been accorded the place in the diet to which it is entitled. This fruit when unripe consists largely of starch and therefore is difficult of digestion; as the ripening process goes on, however, a large part of the starch is converted into sugar. Therefore, bananas should be fully ripe if they are to be eaten raw; the peel should show the black discoloration which appears just before the fruit is over-ripe. Cooked bananas are easily digested. The vitamin content is poor.

The so-called **small fruits,** strawberries, raspberries, blackberries, gooseberries, cranberries and currants, possess the same advantage as other fruits. Raspberries are especially rich in vitamin C. Strawberries are consumed in largest quantity.

Olives are eaten as a relish rather than for the nutritive value of their oil. Ripe olives canned in dilute salt solution (botulism!) are preferable to olives which are pickled in brine.

The *fruit drying industry* has become an important one. In California, peaches, apricots, prunes and raisins are dried in the open air.

Among these, prunes and raisins come first. The value of the former lies chiefly in its laxative effect.

Fruits are also *canned* in large quantities. Pineapple, sliced and canned in syrup, has become a popular food. Vitamins A and B are well preserved in the process of canning.

NUTS

Nuts are as a rule rich in protein and fat and poor in carbohydrate. The chestnut, because of its richness in carbohydrate, forms an exception. Nuts are poor in vitamins A and C, but contain a fair amount of vitamin B. They are lacking in calcium. Observations on fruitarians who have lived largely on fruits and nuts, would indicate that the biologic values of nut proteins are high. Sherman quotes the experiments of Jaffa, which indicated that a fruit and nut diet was easily digested, and that the nut proteins are similar to the proteins of meat or fish.

Eddy and Eckman,[9] in comparing peanut protein with meat protein as a supplement for the protein of wheat flour say: "The peanut flour proved slightly superior to the meat as a growth producer and markedly superior for promoting reproduction." Johns and Finks[10] state: "We have found that peanut flour is an efficient and palatable supplement to wheat flour."

On the other hand, McCollum and Simmonds remind us that nuts are properly to be regarded as the seeds of plants and that we should not expect them to supplement the cereals, legumes, tubers or fruits, except in respect to the protein content. They say:[11] "A diet composed of such combinations of food may be balanced so far as chemical analysis can show but be defective in other respects."

Nuts are regarded as indigestible. True, their compact physical state and their richness in fats may retard the emptying of the stomach and cause discomfort; but the reverse may also be true, and if they are well masticated this retarding influence will often give a sense of satiety and comfort. It has been shown that when thoroughly masticated and eaten with fruits and other foods, the nutritive constituents of nuts are well utilized.

THE DIETARY VALUE OF VEGETABLES, FRUITS AND NUTS

The value to man of vegetables lies in their liberal vitamin content, their richness in minerals, their low cost as sources of energy, and the roughage which they provide.

For vitamin content, the thin green leaves of vegetables come first. Every dietary should contain a liberal amount of these. As sources of vitamin A, spinach, the green leaves of cabbage, lettuce, green string beans, carrots and tomatoes are important. Vitamin B is found in practically all vegetables and fruits; it is widely distributed in nature; leaves, seeds and the juice of the fruits all contain it in liberal quanti-

TABLE 5.—*Average Chemical Composition of Some of the Commoner Fruits and Nuts**

	Water, Per Cent	Protein, Per Cent	Fat, Per Cent	Total Carbohydrate (Including Fiber), Per Cent	Ash, Per Cent	Fuel Value per Pound
FRUITS						
Apples	84.6	0.4	0.5	14.2	0.3	290
Bananas	75.3	1.3	.6	22.0	0.8	460
Blackberries	86.3	1.3	1.0	10.9	0.5	270
Cherries	80.9	1.0	0.8	16.7	0.6	365
Cranberries	88.9	0.4	0.6	9.9	0.2	215
Grapes	58.0	1.0	1.2	14.4	0.4	335
Lemons	89.3	1.0	0.7	8.5	0.5	205
Muskmelons	89.5	0.6	0.0	9.3	0.6	185
Oranges	86.9	0.8	0.2	11.6	0.5	240
Peaches	89.4	0.7	0.1	9.4	0.4	190
Pears	84.4	0.6	0.5	14.1	0.4	295
Prunes	79.6	0.9	0.0	18.9	0.6	370
Raspberries	84.1	1.7	1.0	12.6	0.6	310
Strawberries	90.4	1.0	0.6	7.4	0.6	180
Watermelons	92.4	0.4	0.2	6.7	0.3	140
Fruits, dried						
Apples, dried	28.1	1.6	2.2	66.1	2.0	1,350
Apricots	29.4	4.7	1.0	62.5	2.4	1,290
Dates	15.4	2.1	2.8	78.4	1.3	1,615
Figs	18.8	4.3	0.3	74.2	2.4	1,475
Prunes	22.3	2.1	0.0	73.3	2.3	1,400
Raisins	14.6	2.6	3.3	76.1	3.4	1,605
NUTS						
Almonds	4.8	21.0	54.9	17.3	2.0	3,030
Brazil nuts	5.3	17.0	66.8	7.0	3.9	3,265
Butternuts	4.4	27.9	61.2	3.5	2.9	3,165
Chestnuts	45.0	6.2	5.4	42.1	1.3	1,125
Coconuts	14.1	5.7	50.6	27.9	1.7	2,760
Hickory nuts	3.7	15.4	67.4	11.4	2.1	3,345
Peanuts	9.2	25.8	38.6	24.4	2.0	2,560
Pecans	3.0	11.0	71.2	13.3	1.5	3,455
Walnuts	2.5	18.4	64.4	13.0	1.7	3,300

* This table is taken from U. S. Dept. Agric., Bull. 28.

ties. Vitamin C is present in abundance in the actively functioning parts of the plants, such as green leaves, as well as in tomatoes and the citrus fruits.

The ash constituents of fruits and vegetables add greatly to their value. The green vegetables furnish a most important source of readily assimilable iron, calcium and phosphorus. They also contain a preponderance of other important base-forming elements, such as are needed to counteract the acid tendencies of meats and cereals.

FATS

The most important fatty foods are butter and cream; they present fats in the most palatable, easily assimilated form. They have been discussed with milk.

Butter Substitutes.—A good substitute for butter must be free from all foreign taste and odor and must have a melting point identical with that of butter.

Oleomargarine is the most widely used and acceptable of such substitutes. It is a mixture of several fats blended and treated in such a manner as to give the consistency and appearance of the food which it imitates. Its basis is "oleo oil" which is derived from beef fat after the unsuitable fats with lower melting points, such as stearin and palmitin, have been removed. To this oleo oil, which contains only those fats with a suitable melting point is added a certain amount of neutral lard and occasionally other fats, such as those obtained from the cottonseed, coconut or peanut. This mixture is churned with milk or with true butter until a homogeneous mass is obtained. It is then cooled, salted and "worked" as butter. The consumption of oleomargarine in America is about one-fifth that of the butter.

Other substitutes for butter are made from various vegetable oils. The fats with higher melting points are removed by cooling and pressing, and as a residue there is obtained a mixture which approximates butter in consistency and melting point. The chief difficulty here is in securing a product which in taste and flavor resembles butter rather than the original mother substance.

Lard is made by a refining process from the "leaf fat" of the pig and consists of about 99 per cent fat. It is used largely in cooking. Many substitutes for lard are in use, some of which are distinctly superior.

Cottonseed oil comes first. By a process of chilling and pressing a residue of heavier fats is obtained which can with advantage be substituted for lard. This residue represents about one-fifth of the whole oil. Other substitutes are made by mixing cottonseed oil directly with the heavier fats of "oleo oil."

Cottonseed oil is similar in appearance and flavor to olive oil. In preparation for human consumption it is refined in such a manner as to greatly improve its flavor and to make of it a thoroughly edible food.

The **oil of the olive** is obtained from the ripe fruit. Its flavor and appearance depend on several factors: the kinds of olive used, its ripeness when gathered, and the process of manufacture. For the best oil, the olives should be gathered at the right stage of ripeness; at this time about 50 per cent of the fruit is oil, which, when the skin is broken, exudes spontaneously. This represents the highest grade and is called "virgin oil." The pulp which remains, when subjected to pressure, again yields a liberal quantity of oil which is classed as second grade. Still other grades are obtained by further treatment of the pulp. The oil is immediately filtered and is then allowed to stand for several months.

Olive oil is very much desired, chiefly as a salad dressing. Beyond its agreeable flavor, however, it possesses little advantage over the other edible vegetable oils. There are numerous substitutes and imitations; many of these consist of cottonseed oil or mixtures of cottonseed oil with the lower grades of olive oil.

Peanut oil is coming into wider use. It is similar to olive oil but has a tenacious, characteristic flavor.

Corn oil is used largely in the trades and arts and also in feeding cattle. It is coming into favor as a food for man.

The Place of Fats and Oils in the Diet.—The full caloric value of the diet cannot easily be obtained without the inclusion of fat, for this foodstuff yields more than twice as many calories as the same quantity of carbohydrate or protein. Not only is this need for fat experienced in health, but it is felt also in certain diseases, such as diabetes, when it is necessary to meet the patient's caloric needs and at the same time throw the least possible burden on his metabolism. The richness of certain fats, notably butter, cream and the fish oils, in vitamins, particularly in vitamin A, adds greatly to their desirability. Pediatrists have suggested another reason for including fat in the diet. In children, the stools are not of proper consistency, and digestion does not proceed normally unless the food contains a certain amount of fat.

Fatty foods are believed to be indigestible. It is true that an excessive amount of fat in the diet of susceptible people will cause intestinal disturbances. Much depends, however, on the nature of the fat. Those fats which melt at the temperature of the body are most easily assimilated, while those with a high melting point (stearin) are poorly utilized. It is possible, however, to mix widely differing fats in such proportions as to obtain a product which has the proper melting point and therefore is readily assimilated.

Completeness of utilization and ease of digestion, both of which are included in the terms digestibility, have entirely different meanings. The utilization of the edible fats is good. Ease of digestion varies with the digestive peculiarities of the individual and with the form in which the fat is eaten. Fatty foods leave the stomach slowly and in susceptible persons will cause a feeling of weight and heaviness. On the other hand, retardation of emptying time may lead to a desirable sense of comfort and satisfaction. This increase in the satiety value which fat gives to a meal is an important thing. Warning, however, should be given against the eating of improperly fried foods, since these are often so thoroughly impregnated with fat as to prevent ready access of the digestive fluids.

FOOD ADJUNCTS: CONDIMENTS

Table salt is a fine, white, crystalline substance containing about 99 per cent of sodium chloride. To prevent caking through the absorption of moisture, some other substance, such as starch, is often added. For the benefit of those whose food and water are lacking in iodine, a minute amount of potassium iodide[12] also is sometimes added.

Salt gives zest to many foods which otherwise would be tasteless; in proper amounts it brings out the natural flavor of the food, but if eaten to excess it masks this flavor and eventually blunts the person's finer sense of taste. The excessive consumption of salt, which is a frequent dietary fault, may be injurious.

Sodium chloride is not merely a food adjunct; it is a necessity, for the natural foods supply an insufficient amount to meet the animal's needs. I have seen a salt-free diet—one in which literally no salt is added to the food—lead to marked weakness. Wild animals will travel long distances to reach a salt lick; and primitive races have gone to war for want of salt.

For the average person, 2 Gm. daily of added salt is sufficient; this includes both that supplied in the kitchen and that taken at the table.

Vinegar is a dilute solution of acetic acid and other substances. It is used to soften the fiber and to give a sour flavor to many foods which ordinarily have little taste. It was originally made from apple cider through alcoholic fermentation and the subsequent formation of acetic acid. Now it is made also from barley and other cereals, as well as by dilution of concentrated acetic acid solutions to which are added flavoring and coloring materials. Vinegar should contain not less than 4 per cent of acetic acid.

As a rule, *spices* contain some volatile oil which adds piquancy to the food. Allspice, anise, cinnamon, cloves, ginger, horse-radish, mustard, nutmeg, mace, paprica and pepper are commonly used. Taken sparingly, they are of value; their abuse is disastrous to the taste.

Flavoring extracts are alcoholic solutions of the savory or fragrant principle of aromatic plants. The flavor which they give to the food often depends as much on the odor as on the actual taste. Vanilla and lemon extracts are widely used. Others are cinnamon, ginger, almond, peppermint, orange and wintergreen.

BEVERAGES

Coffee and Tea.—*Coffee* is an infusion made from the roasted bean of *Coffea arabica* or *Coffea liberica*. It is taken chiefly for the stimulating effect of its alkaloid caffeine and also because of the pleasantly aromatic flavor which comes from its volatile oil, coffeol. The caffeine of coffee is in loose chemical combination with some other substance, probably as caffetannic acid. It has been noted that the stimulation derived from a cup of coffee is slower in reaching its maximum and lasts longer than that from the caffeine beverages served at soda fountains. In the former, caffeine is probably released slowly from its tannic acid combination, while in the latter, it is immediately available.

The manner in which coffee is made determines largely its flavor and strength, whether by boiling, steeping, percolation or filtration. The making of good coffee is an art.

Tea is an infusion of the leaves and leaf buds of the tea bush, *Thea*. The cheering and mildly invigorating effect of this drink, like that of coffee, comes from caffeine. The quantitative relation of this alkaloid to the tannin which is also present probably determines the quality of the tea; good tea should have neither too much caffeine nor too much tannin.

There are many grades of tea on the market; the flowery pekoe and the orange pekoe are the best. The color of the leaves, whether green or black, depends on the method of preparation, the latter having been subjected to a fermentative process which removes some of the tannin. To get best results and avoid an excess of tannin in the making of tea only freshly boiled water should be used, and it should not remain in contact with the leaves for more than five minutes.

Effects of Tea and Coffee.—Since the physiologic influences of both coffee and tea come from the caffeine which each contains, the two can be discussed together. Caffeine raises slightly the blood pressure, slows and strengthens the heart, stimulates renal activity, and prevents fatigue and depression. The most noticeable effect of these beverages is a mild cerebral stimulation; they clear away the "cobwebs." It is doubtful, however, if in the long run the mental labor ultimately accomplished can be increased by coffee or tea.

The comfort and cheer obtained from a cup of coffee or tea cannot be attributed solely to its caffeine. The former drink contains certain aromatic oils which are pleasing to the taste and mildly stimulating to the stomach. Coffee, by retarding slightly the emptying of the stomach, also increases the satiety value of the meal. Taken hot these beverages stimulate gastro-intestinal motility, and when taken cold in hot weather are very refreshing.

The tannin contained in these beverages, especially in tea, is believed to interfere with digestion. In properly made tea, however, the tannin is largely, if not entirely, in combination with caffeine and probably has no harmful effect.

The excessive use of coffee or tea is harmful to a high degree. Stimulation and irritation lie very close together, and caffeine when taken in relatively large doses irritates instead of cheers. Some dispositions are ruined by caffeine. It produces insomnia; true, many people state that coffee or tea will permit them to relax and sleep; as a rule, however, this is followed later in the night by a period of insomnia. Too much coffee or tea will cause cardiac irritability and produce rapid heart action. Even such a small amount as one cup a day will, when the heart is already irritated, as in hyperthyroidism, accentuate the trouble.

The whole civilized world (and much of the uncivilized) drinks coffee and tea. Much cheer and comfort is thereby obtained, but it cannot be said that through them man's productivity, whether intellectual or physical, is increased. When these beverages are taken in moderation no appreciable harm is done; one cup of coffee or tea a day is possibly all right; more than this is distinctly harmful. The tendency today is to rely too much on coffee, tea and other caffeine containing drinks.

Cocoa and Chocolate—These beverages are made from the cocoa bean of *Theobroma*, the cocoa tree. After the bean has been roasted and freed from the germ and shell, the resulting "cocoa nibs" are ground and mashed into a solid mass. This forms the plain or bitter chocolate of commerce. Mixed with sugar, flavoring extracts and other substances, it becomes sweet chocolate. If milk is used, it is milk chocolate. Cocoa is made by removing from chocolate a part of its fat.

Chocolate and cocoa contain an alkaloid, theobromine, which is akin to caffeine but which does not exhibit its stimulating properties. Beverages made from chocolate and cocoa are aromatic and pleasant. The oil contained in them has food value, but the chief value lies in the milk and sugar which are added. The richness of chocolate sometimes interferes with digestion. Cocoa forms a pleasing vehicle for milk.

Fruit juices are refreshing and, because of the sugar they contain, nourishing. Grape juice, orange juice and lemonade are of value in feeding the sick. By the judicious use of such beverages between regular feedings, a considerable amount of easily assimilated carbohydrate can be administered.

Mineral Waters.—Unbounded faith in the life-giving properties of the mineral spring is a thing of the past. The time was when mineral waters were credited almost universally with therapeutic powers of marvelous extent. Waters which contained the most diverse minerals were believed to cure the same disease, and often a single kind of water was said to be efficacious in the widest variety of unrelated disorders. In many instances these claims were based on faith alone, in others on an erroneous conception of the disease in question. For example, the popularity of lithia water dates back to the time when uric acid was believed to be a factor in the production of nephritis, and because the lithium salt was said to be more soluble than other urates, waters containing this element were recommended. Long after the fallacy in the original premise was evident, lithia water enjoyed great popularity in the treatment of nephritis. Today our attitude toward mineral waters is more critical.

It has long been evident that the medicinal properties claimed for these waters could not possibly rest on their mineral content as shown by ordinary chemical analysis. And yet the continued popularity of many of these spas is such that they must be credited with curative influences of some kind. Two factors must be reckoned with: (1) the psychic influences and general hygiene of the spa, and (2) certain physical properties of the waters. The first of these are well known. Change of climate, pleasant surroundings, good food, absence from work and worry, and rigid adherence to certain rules of hygiene laid down by the "Bad-Arzt," as well as abiding faith in the efficacy of the water—which faith permeates the entire atmosphere—all taken together account in large measure for the cures accomplished at the various watering places.

Spring water as it comes from the earth may possess, however, certain physical properties which do not appear on chemical analysis. The radio-activity of some of these waters may have therapeutic value. And yet, measurement of the radio-activity of some of the more popular of the waters would not indicate that their reputed therapeutic efficacy bears any definite relationship to their content of radiant energy. This factor may be of some influence, but since the water loses its radiant energy within a relatively short time after release from the earth, such influence does not attach itself to bottled waters.

Recently Baudisch and Welo,[12] working in the laboratories of the Rockefeller Institute, have made observations which would indicate that the physical state in which the element exists in the water is perhaps of influence. They studied particularly the iron dissolved in the waters of certain springs and reached the conclusion that mineral salts enter into solution in the underground waters in a "labile configuration" perhaps, and that after aging this configuration is changed so that the salt loses its former physical characteristics. If this is true, it explains in a measure why certain waters appear to be of therapeutic value when taken at the spa but do not exhibit that value after aging. All of this would lead to the conclusion that bottled natural mineral waters possess no value not exhibited equally well by salts of similar nature dissolved in artificial waters.

Mineral waters may be classified as follows:[13]

Alkaline waters; these contain sodium bicarbonate, often in combination with sodium chloride and with sodium sulphate. They are of value in proportion to the alkali contained in them. Capon Springs, Virginia; Saratoga Springs, New York; Glenwood Springs, and Manitou Soda Springs, Colorado; belong in this group. Among the foreign alkaline waters are those of Calsbad, Marinebad and Fachigen.

Bitter waters are those which contain magnesium sulphate and therefore have laxative qualities. Apenta water and the water of Tate Spring, Tennessee, belong in this group.

Chalybeate or *iron waters* are those which contain iron in medicinal quantities. Springs of this type are numerous everywhere, among which may be mentioned Sharon Springs and Saratoga Springs in this country and Turnbridge Wells in England.

Calcareous waters are those which contain the alkaline earths, calcium and magnesium. The springs at Waukesha and Clifton Springs in this country, at Bath, England, and Wildigen, Austria, are of this group.

Sulphur waters are those which contain sulphides and occasionally chlorides. They are numerous but their great popularity, except for the hygienic and social features of the spa, have gradually waned. Santa Barbara Springs, California, Hot Sulphur Springs, and Glenwood Springs, Colorado, and Blount Springs, Alabama, belong in this group. Many of the more popular European spas are of this type, among them Aix-les-Bains, Aix-la-Chapelle and Baden.

Arsenical waters are those which contain arsenites or arsenates. The Crocket Arsenic Lithia Springs in Virginia and the Harbin Hot Sulphur Springs of California are of this type.

ALCOHOLIC BEVERAGES

Alcohol is oxidized in the body and in small quantities may be used in metabolism to replace isodynamic quantities of carbohydrate or fat. Atwater and Benedict[14] observed that a man at rest taking an ordinary diet of 2,500 calories or at work taking 3,500 calories burned 98 per cent of the 72 Gm. of alcohol (500 calories) given him. Notwithstanding its ready availability as a source of energy, it can never be depended on, however, as the principal form of nourishment. Lusk states that those who are accustomed to its use will oxidize a reasonable intake in seven and one-half hours, while those unaccustomed to its use require twice that time.

Alcoholic beverages as a rule are taken for two purposes: for their flavor, and for the sense of well-being which they give. Since the sale of wines, beers and other alcoholic beverages with agreeable taste has been prohibited in this country, we need not consider the quality of flavor. The only question of interest here is the use of alcohol as a food and as a food adjuvant. There are times in the treatment of disease when alcoholic beverages are unquestionably of help. In the feeding of elderly people and of those with debilitating disease it is of definite value. Such beverages taken with the meal often improve appetite and digestion. I have known nervous dyspepsia to be definitely cured and the patient's enjoyment of life enormously enhanced by two small drinks of whiskey daily. Alcohol will sometimes remove the inhibiting influences of worry, anxiety and exhaustion, and thus permit the person to relax and to secure rest, which otherwise perhaps would not be obtainable. Rest, both mental and physical, is a therapeutic factor of far-reaching importance. It has been argued that opium will do the same thing, but this is not true, for in their beneficial influences and their ill effects the two are in no wise comparable.

On the other hand, the enormous amount of poverty, misery, and unhappiness which comes to the race from the unrestricted consumption of alcohol greatly outweighs the benefits which its judicious use may bring to a few persons; therefore we are compelled to admit that prohibition if enforceable is a good thing. But this should not obscure the fact that alcoholic beverages properly used at the proper time may be of benefit. The alcoholic content and food value of the various beverages are given in the table of food values at the end of this book.

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SECTION C

DIET IN HEALTH

CHAPTER VIII

THE NORMAL DIET—RÉSUMÉ

The assumption is often expressed that the normal person, when free to choose, will select the food best suited to his needs. Within limits, this is true. If the supply is adequate, he can usually be trusted to eat enough to meet his requirements for energy; but whether the food will be of the right kind and whether it will supply in sufficient amounts all minerals, vitamins and other necessary substances, is another question. Fortunately, custom determines the arrangement of the meals and decrees the kinds of food to be eaten; and the experience of the race fixes the custom. This often prevents the individual, unless his dietary peculiarities are pronounced, from wandering very far from nutritive safety. On the other hand, in our complex civilization so many fortuitous circumstances influence the choice of food, and so often in its preparation the food itself is robbed of important nutritive substances, that chance and the dictates of appetite and taste are not always to be trusted. Observation indicates that nutritional failure—not absolute, but relative—resulting in many vague, ill defined states of ill health, is of frequent occurrence.

People as a rule need instruction in nutrition. They should be told of the dangers of nutritional failure and of how to avoid them. This should include information as to fuel values, as to the fundamental food factors, and as to the kinds of food which are best suited to man's needs. Such instruction is being carried on today in the public schools, in current periodicals and in books. Unfortunately, some of the advice which finds its way into the newspapers and magazines, usually as advertising matter, is misleading and can be classed as "bunk." On the whole, however, people are becoming more and more enlightened and are giving constantly more thought to the subject of nutrition.

There are certain members of society whose duty it is thoroughly to familiarize themselves with the science of nutrition, and to make appropriate use of this knowledge. These may be classed roughly into five groups: (1) physicians who must advise the sick and the near sick; (2) teachers who must instruct the young; (3) nutrition workers, the majority of whom work with school children and their parents; (4) social service workers, who must offer advice to mothers and expectant mothers and who must concern themselves with economic considerations as related to the food of the family; (5) officials whose duty it is to feed large numbers of persons, as in boarding schools, hospitals, hotels, prisons, armies, etc.

For the proper selection of food, we should be governed, consciously or unconsciously, by four fundamental dietary considerations: (*a*) fuel requirement, (*b*) protein intake, (*c*) mineral metabolism, and (*d*) the need for vitamins. None of these factors can safely be neglected; they were discussed at length in earlier chapters. In addition, attention should be given to certain other less important factors, such as satiety values, roughage, ease of digestion, the economic status of the individual and the cost of food.

The fuel requirement has already received thorough discussion in Chapter III where tables indicating the caloric needs under varying conditions are given. For more detailed information in this regard the reader is referred to that chapter. Under ordinary circumstances, it is not necessary that a person's requirement be estimated to a nicety; it suffices merely to form a rough estimate based on the tables above mentioned, particularly those on page 66. As a rule, it is appropriate to assume that an American man (or woman) who leads a quiet life at home with little exercise requires about 2,500 calories; that if he is engaged in a sedentary occupation, 3,000 calories are required; that if he engages in a moderate amount of exercise or is a laborer doing light work, he can get along on 3,500 calories; and that if he does hard work, 4,000 calories or even more are necessary. Such rough estimates are easy to remember and, while liberal, are sufficiently accurate for most purposes.

Regarding the need for protein, many physiologists and students of nutrition hold that the proponents of economy in nutrition, led by Chittenden, are right, and that for the average man a daily intake of 50 to 60 Gm. of protein is proper. Sherman adds to this and estimates that man can get along satisfactorily on 75 Gm. daily. Animal experiments and other considerations, however, would suggest that even this latter estimate hardly allows a sufficient margin of safety, and that in order to insure continued vigor and normal longevity the diet should provide daily approximately 100 Gm. of good protein.

Those who do hard work are accustomed to consume proportionately more protein, this in spite of the fact that metabolic studies have shown that muscle work is done at the expense of carbohydrate and not of protein and that work does not increase protein wear and tear. It is fair to say, however, that recent experiments would indicate that nitrogen metabolism, after all, is increased to a small degree by hard work, and that it is proper to permit the laborer a certain additional amount of protein.

Intimately connected with this problem of the amount of protein is the almost equally important question of its source. Biologic values have been discussed elsewhere; the necessity for providing protein or protein mixtures which will supply all of the necessary amino-acids in sufficient amounts has also been emphasized. These are found chiefly in milk, meat and eggs. The proteins of legumes and other vegetables, though of comparatively low biologic value, are utilizable and are of greatest value when supplemented by proteins of a higher order. For economy in nutrition and to insure an adequate supply of amino-acids, the diet should provide milk, eggs and, as a rule, a certain amount of meat.

In general, then, 1.5 Gm. of protein per kilogram of body weight may be regarded as appropriate for the average adult. The child, however, requires more, say 2 Gm. per kilogram; for he constantly adds protein to his body structure. These figures are based on the assumption that the food contains proteins of good biologic value.

After the total fuel requirement has been determined and the protein quota fixed, thought should be given to the distribution of the remaining calories between carbohydrate and fat. A liberal carbohydrate intake is essential to the proper utilization of both protein and fat. Nitrogen balance can be maintained at an economical figure only when at least half the energy value of the diet is in the form of carbohydrate. Fat, as has been aptly said, burns in the fire of carbohydrate; if there is insufficient carbohydrate, the fat is not properly utilized. Therefore, the bulk of the diet, as regards both energy value and physical qualities, should be in the form of carbohydrate.

Voit's estimate of man's nutritive needs, which calls for about 3,000 calories, is: protein, 118 Gm., carbohydrate, 500 Gm., fat, 56 Gm. Other physiologists have suggested similar amounts. It should be emphasized that these figures are mere guides, and that they may safely be varied within wide limits.

It was learned from Sherman's studies of American dietaries and from other sources, that the average diet cannot be trusted to provide always a sufficient amount of mineral salts. The elements most often lacking are calcium, iron and phosphorus, chiefly the first named. Man's daily requirement for these is roughly as follows: calcium, 0.7 Gm., phosphorus, 1.5 Gm., iron, 0.015 Gm. A child requires less of each of these elements in total amount but materially more per kilogram of body weight.

Milk is the best source of the inorganic elements, particularly of calcium. True, it is poor in iron, but an abundance of this element can be secured from lean meats, eggs and vegetables. Because of this richness in mineral elements, milk in liberal quantities is advisable for the nursing mother; for the growing child it is essential.

The average American dietary is often lacking in vitamins. This is true particularly of the food provided in large institutions. It is a relatively simple matter to secure an abundance of vitamins, provided milk, fruits, tomatoes and the leafy portion of green vegetables are taken in liberal amounts. Unfortunately, many people dislike milk and find it difficult to secure fruits and green vegetables. Since chronic vitamin deficiency—not in the form of well defined clinical disease but rather as vague indefinite ill health—is frequent, effort should be made to avoid such deficiency by including in the diet fruits, a liberal quantity of the leafy portion of green vegetables, such as lettuce, spinach, cauliflower and cabbage, and whenever possible, a certain amount of milk. Of the family budget, Sherman says:[1] "It therefore seems advisable to spend at least as much for fruit and vegetables as for meat and fish; also to spend at least as much for milk as for meat (or for milk and cheese as for meat and fish)."

The need for roughage will usually be met when the person eats the green vegetables above advised. If this is insufficient, bran can be added.

The food should be palatable, else it will not be eaten. It should always be satisfying, and to this end attention should be given to its satiety value. Meats have the greatest satiety value of all foods—they "stick to the ribs" longest; soups, because of the meat extractives contained in them, also enhance greatly the satiety value of a meal. Fats, especially butter spread on bread, do the same. A simple dessert or other sweet taken after a meal increases the satisfying quality of the entire repast. Thus is seen the rationale of the type of meal which civilized man has instinctively chosen: a soup at the beginning, meat as the "pièce de résistance," and at the end a sweet.

Man's dietary needs may be summarized as follows:[2] In order to enjoy robust health and to avoid the results of nutritional failure, he should each day drink one quart of milk and eat two salads and two liberal helpings of the leafy portion of green vegetables; he should eat one small helping of any meat and perhaps two eggs; to this he may add anything else within reason which his appetite demands, including a liberal supply of bread, butter, fruits and the various vegetables. If he will do this, the state of his nutrition will not suffer.

Following this discussion of dietary standards and of numerically expressed food values, it is necessary to say a word of warning against slavish adherence to iron clad rules. Numerical standards should be governed by circumstances and must change accordingly; for instance, the amount of iron necessary for equilibrium varies with the calcium intake; calcium and phosphorus in their metabolism are to a certain extent mutually interdependent, and vitamin requirement often depends on the nutritive state of the individual. Principles alone are of paramount importance. Figures are mere guides, and a thorough understanding of the principles of nutrition, together with good judgment, should govern the use of dietary standards.

THE CHILD OF SCHOOL AGE

The dietary needs of the child of school age demand special consideration for the following reasons: His great activity requires a disproportionately large caloric intake; his rapid growth calls for an abundance of good protein and of mineral salts; his need for vitamins is even more imperative than that of the adult; in the interest of good digestion, he should have simple, clean, easily digested, well prepared food; and the early acquisition of good dietary habits, particularly in the choice of food, is of lasting importance.

The Total Quantity of Food.—The quantity required by the child is determined by several factors: basal metabolism, growth, activity, stimulus received from food, and losses in the excreta.

The basal metabolism of infancy and childhood has been exhaustively studied by Benedict and Talbot; their formula for estimating the basal rate of children has been given in Chapter III. For the convenience of the clinician, these authors have prepared also the following table which gives the basal metabolism of boys and girls according to weight.[3] It should be emphasized, however, that these figures express merely the average and that even among normal children wide variations are encountered.

The ratio of growth, as evidenced by gain in stature and weight, increases gradually from the tenth year. This increase is such that in the girl's thirteenth year and the boy's sixteenth year the ratio of gain is double that seen in the early years of school life.

The amount of food which must be added in order to take care of the child's great activity is difficult accurately to determine. All writers agree that it is great. Benedict and Talbot[4] express the opinion that this increase in caloric output above the basal for children in the school room is 75 per cent for boys and 50 per cent for girls. Lusk[5]

TABLE 1.—*Basal Heat Production of Boys and Girls per Twenty-four Hours Predicted from Body Weight**

Body-weight (Without Clothing),	Predicted Heat,		Body-weight (Without Clothing),	Predicted Heat,		Body-weight (Without Clothing),	Predicted Heat,		Body-weight (Without Clothing),	Predicted Heat,	
	Boys	Girls		Boys	Girls		Boys	Girls		Boys	Girls
kilos.	*cals.*	*cals.*	*kilos.*	*cals.*	*cals.*	*kilos.*	*cols.*	*cals.*	*kilos.*	*cals.*	*cals.*
2.5	115	110	11.5	607	595	20.5	873	818	29.5	1,103	1,032
3.0	150	150	12.0	625	610	21.0	885	830	30.0	1,115	1,045
3.5	180	185	12.5	643	625	21.5	898	842	30.5	1,127	1,058
4.0	210	220	13.0	660	640	22.0	910	855	31.0	1,140	1,070
4.5	240	253	13.5	678	652	22.5	925	867	31.5	1,150	1,080
5.0	270	285	14.0	695	665	23.0	940	880	32.0	1,160	1,090
5.5	300	318	14.5	710	678	23.5	953	890	32.5	1,170	
6.0	330	350	15.0	725	690	24.0	965	900	33.0	1,180	
6.5	360	377	15.5	740	700	24.5	978	915	33.5	1,190	
7.0	390	405	16.0	755	710	25.0	990	930	34.0	1,200	
7.5	418	432	16.5	768	722	25.5	1,005	940	34.5	1,210	
8.0	445	460	17.0	780	735	26.0	1,020	950	35.0	1,220	
8.5	470	480	17.5	793	747	26.5	1,033	962	35.5	1,230	
9.0	495	500	18.0	805	760	27.0	1,045	975	36.0	1,240	
9.5	520	520	18.5	818	770	27.5	1,058	987	36.5	1,248	
10.0	545	540	19 0	830	780	28.0	1,070	1,000	37.0	1,255	
10.5	568	560	19.5	845	793	28.5	1,080	1,010	37.5	1,265	
11.0	590	580	20.0	860	805	29.0	1,090	1,020	38.0	1,275	

* This table is taken from Benedict, F. G., and Talbot, F. B.: Metabolism and Growth from Birth to Puberty.

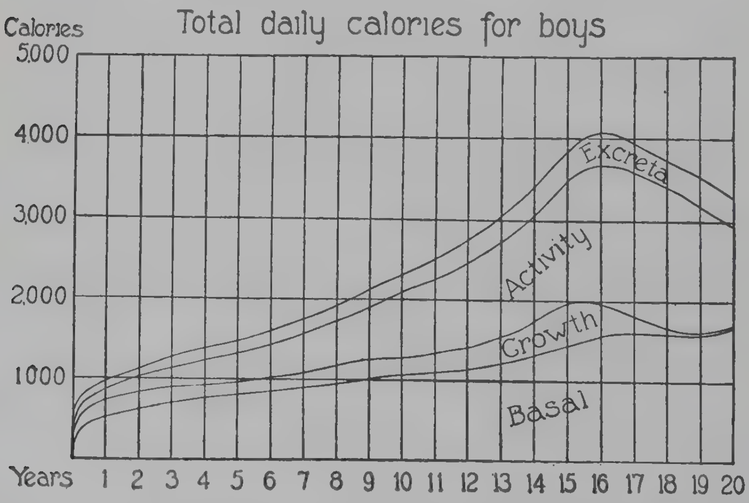

CHART 1.—The distance between the base and the upper line shows the allowance for total daily calories according to age, from birth to adult life. The spaces between the various lines, from the base line upward, indicate the allowance for the different factors which make up the total, namely, for basal requirement, growth, activity and loss in excreta. (Charts 1 and 2 are taken from Holt, L. E., and Fales, H. L.: Am. J. Dis. Child. **22**: 371, 1921.)

estimates that the active child requires about double the food of the very quiet child. This estimate is perhaps low for the most active type, say the boy of 12 years, for at this age he often requires more food than his father. For instance, Gephart[6] observed, at St Paul's School that many boys of 14 years of age take over 5,000 calories daily; this probably represents the peak of activity and the maximum need for food. Holt and Fales[7] have reviewed the literature and have made certain observations of their own. It is interesting that their observations on the amount of food actually consumed by 100 healthy boys and girls coincides closely with the predicted requirements of these same children. Charts 1 and 2 express their estimate of the total caloric output (and therefore the daily need) divided into its several components.

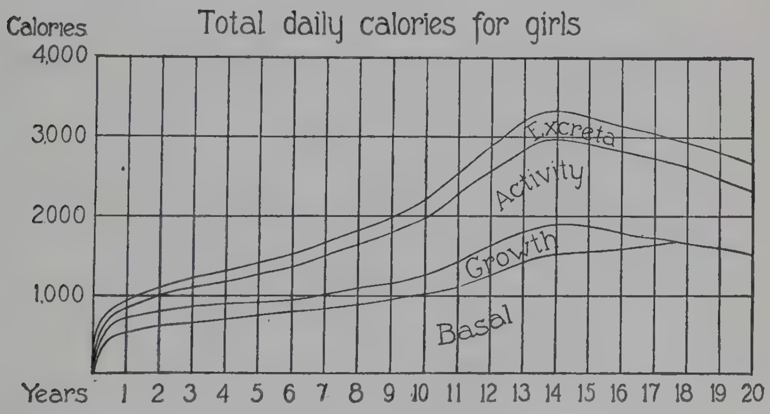

Chart 2.—The curved lines and spaces have the same significance as in Chart 1.

Tables 2 and 3, compiled by the same authors, give the estimated caloric output referred to body weight; and table 3 similar data referred to age.

From these tables, we can assume roughly that on entering school at the age of 6 years, the boy needs 1,600 calories and the girl 1, 500; and that at 10 years, the former requires 2,300 calories and the latter 2,200. During the next few years, the girl's needs slightly exceed those of the boy; at 12 years, their requirements are 2,700 and 2,800 calories, respectively. At 15 years, the boy's needs are again greater, being 3,800 calories as against the girl's 3,200.

Composition of the Diet.—The *protein problem* was discussed at length in an earlier chapter, and the conclusion was reached that in order to preserve health and vigor and to experience normal longevity

TABLE 2.—*Suggested Calories per Kilogram for Boys**

Weight, Kilograms	Calories per Kilogram					Per Cent of Calories for				Total Calories Daily
	Basal	Growth	Activity	Excreta	Total	Basal	Growth	Activity	Excreta	
3	46	56	8	10	120	38	47	7	8	360
4	50	52	8	10	120	42	43	7	8	480
5	54	46	8	10	118	46	39	7	8	590
6	56	38	10	10	114	49	33	9	9	685
7	57	32	11	10	110	52	29	10	9	770
8	56	28	12	10	106	53	26	11	10	850
9	55	25	12	10	102	54	24	12	10	920
10	54	22	13	10	99	55	22	13	10	990
11	53	19	14	10	96	55	20	15	10	1,060
12	52	16	16	9	93	56	17	17	10	1,120
13	51	14	17	9	91	56	16	18	10	1,180
14	50	13	17	9	89	56	15	19	10	1,240
15	49	12	17	9	87	56	14	20	10	1,300
16	48	10	18	9	85	56	12	22	10	1,360
17	47	9	19	8	83	56	11	23	10	1,410
18	46	8	20	8	82	56	10	24	10	1,470
19	45	7	21	8	81	56	9	25	10	1,540
20	44	7	23	8	80	55	9	26	10	1,600
22	42	7	23	8	80	53	9	28	10	1,760
24	41	8	23	8	80	51	10	29	10	1,920
26	39	8	25	8	80	49	8	31	10	2,080
28	38	7	27	8	80	47	9	34	10	2,240
30	36	7	29	8	80	45	9	36	10	2,400
33	35	7	30	8	80	44	9	37	10	2,640
36	33	8	31	8	80	41	10	39	10	2,880
39	32	9	31	8	80	40	11	39	10	3,120
42	31	10	31	8	80	39	12	39	10	3,360
45	30	11	31	8	80	38	13	39	10	3,600
48	30	11	31	8	80	38	13	39	10	3,840
51	29	11	31	8	79	38	13	39	10	4,030
54	29	8	31	8	76	38	11	41	10	4,100
57	28	5	30	7	70	40	7	43	11	3,990
60	27	2	27	7	62	43	3	44	10	3,720
68 (Adult)	25	0	18	5	48	52	0	38	10	3,265

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* This table is taken from Holt, L. E., and Fales, H. L.: The Food Requirements of Children—Total Caloric Requirements, Am. J. Dis. Child. **22**: 371, 1921.

TABLE 3.—*Suggested Calories per Kilogram for Girls* (*Holt and Fales*)

Weight, Kilograms	Calories per Kilogram					Per Cent of Calories for				Total Calories Daily
	Basal	Growth	Activity	Excreta	Total	Basal	Growth	Activity	Excreta	
3	51	51	8	10	120	43	43	6	8	360
4	53	49	8	10	120	45	41	6	8	480
5	55	45	8	10	118	47	38	7	8	590
6	56	38	10	10	114	49	33	9	9	685
7	56	33	11	10	110	51	30	10	9	770
8	57	27	12	10	106	54	25	11	10	850
9	56	24	12	10	102	55	23	12	10	920
10	55	21	13	10	99	56	21	13	10	990
11	53	19	14	10	96	55	20	15	10	1,060
12	51	17	16	9	93	55	18	17	10	1,120
13	49	16	16	9	90	54	18	18	10	1,170
14	47	14	17	9	87	54	16	20	10	1,220
15	45	12	19	8	84	54	14	22	10	1,260
16	44	11	19	8	82	54	13	23	10	1,310
17	43	10	19	8	80	54	12	24	10	1,360
18	42	9	19	8	78	54	12	24	10	1,400
19	41	8	20	8	77	53	11	26	10	1,460
20	40	7	21	8	76	53	9	28	10	1,520
22	38	8	22	8	76	50	11	29	10	1,670
24	37	8	23	8	76	49	11	30	10	1,820
26	36	8	24	8	76	48	10	32	10	1,980
28	36	8	25	8	77	47	10	33	10	2,155
30	36	9	26	8	79	46	11	33	10	2,370
33	35	10	27	8	80	44	12	34	10	2,640
36	35	10	27	8	80	44	12	34	10	2,880
39	35	10	27	8	80	44	12	34	10	3,120
42	34	9	27	8	78	44	11	35	10	3,275
45	34	7	26	7	74	46	9	35	10	3,330
48	33	5	22	7	67	49	8	33	10	3,215
51	32	3	21	6	62	51	5	34	10	3,160
54	31	0	18	5	54	57	0	33	10	2,915
60 (Adult)	25	0	15	4	44	57	0	33	10	2,640

TABLE 4.—*Suggested Total Daily Calories (Holt and Fales)*

Age, Years	Boys					Girls				
	Average Weight		Calories per		Total Daily Calories	Average Weight		Calories per		Total Daily Calories
	Kilogram	Pound	Kilogram	Pound		Kilogram	Pound	Kilogram	Pound	
1	9.5	22	100	45	950	9.3	21	101	45	940
2	12.2	27	93	42	1,135	11.8	26	94	43	1,110
3	14.5	32	88	40	1,275	14.1	31	87	40	1,230
4	16.4	36	84	38	1,380	15.9	35	82	37	1,300
5	18.2	40	82	37	1,490	18.2	40	78	36	1,410
6	20.0	44	80	36	1,600	20.0	44	76	34	1,520
7	21.8	48	80	36	1,745	21.8	48	76	34	1,660
8	24.0	53	80	36	1,920	23.9	53	76	34	1,815
9	26.4	58	80	36	2,110	26.2	58	76	34	1,990
10	29.1	64	80	36	2,330	28.5	63	77	35	2,195
11	31.4	69	80	36	2,510	31.5	69	80	36	2,520
12	34.2	75	80	36	2,735	35.8	79	80	36	2,864
13	38.0	84	80	36	3,040	40.6	89	79	36	3,210
14	42.5	94	80	36	3,400	45.0	99	74	34	3,330
15	48.2	106	80	36	3,855	48.3	106	67	30	3,235
16	54.5	120	75	34	4,090	51.0	112	62	28	3,160
17	57.5	127	69	31	3,945	52.6	116	58	26	3,060
18	59.8	132	62	28	3,730	52.8	117	56	25	2,950
Adult	68.0	150	48	22	3,265	60.0	132	44	20	2,640

a person must eat a liberal quantity of good protein. This applies with especial force to the child, for his food should provide not only for maintenance, but also for growth.

With the lower animals, feeding experiments have shown that in order to maintain normal growth and development the young must receive a liberal amount of good protein, and that animals which have been reared on a minimal protein ration show prematurely the degenerative changes of age. There is good reason for assuming that the results of these experiments can be applied to the human young as well.

The protein of the child's food should be of high biologic value; that is, it should supply abundantly all of the amino-acids which enter into the structure of his own body tissues. A protein which is lacking in an essential amino-acid, when taken as the sole protein food, will not support life. If such an amino-acid is insufficient in amount, it becomes the limiting factor which determines the value of the protein.

The proteins of milk are of high biologic value. Those of meat and eggs also rank high in this respect, but obviously they are not so important to the child as those of milk. The proteins of the cereal grains, of legumes and of other vegetables are of relatively low biologic value and should not be depended on as sole sources of protein. The last are readily utilized, however, when supplemented by others of higher quality, especially those of milk; for this reason the addition of milk to a cereal enhances greatly its nutritive value.

Table 5.—*Average Protein Intake of the Children Studied (Holt and Fales)*

Age, Years	Boys					Girls					Both Sexes				
	Number of Cases	Total Protein, Gm. Daily	Protein per Kilogram	Per Cent. Animal Protein	Per Cent. Vegetable Protein	Number of Cases	Total Protein, Gm. Daily	Protein per Kilogram	Per Cent. Animal Protein	Per Cent. Vegetable Protein	Number of Cases	Total Protein, Gm. Daily	Protein per Kilogram	Per Cent. Animal Protein	Per Cent. Vegetable Protein
1– 2	2	32	3.2	75	25	5	49	4.4	70	30	7	44	4.1	71	29
2– 3	4	48	3.4	71	29	7	56	4.1	72	28	11	53	3.9	71	29
3– 4	6	51	3.8	71	29	4	68	4.4	68	32	10	58	4.0	70	30
4– 5	7	57	3.3	70	30	5	53	3.0	70	30	12	56	3.2	70	30
5– 6	5	63	3.3	70	30	5	58	3.3	64	36	10	60	3.3	67	33
6– 7	4	70	3.0	63	37	4	50	2.5	68	32	8	60	2.7	67	33
7– 8	2	69	2.7	56	44	3	66	2.7	59	41	5	67	2.6	58	42
8– 9	4	80	3.1	71	29	5	75	2.7	70	30	9	78	2.9	70	30
9–10	5	88	3.0	63	37	4	68	2.5	68	32	9	80	2.8	64	36
10–11	6	107	3.5	69	31	3	73	2.2	64	36	9	96	3.1	68	32
11–12	3	82	2.2	64	36	1	77	2.1	73	27	4	80	2.2	64	36
12–13	1	87	1.9	59	41	2	73	1.6	69	31	3	78	1.7	65	35
13–14	..	...	...	..	..	1	74	1.7	60	40	1	74	1.7	60	40
14–15	2	162	3.4	63	37	1	66	1.4	57	43	3	130	2.4	6	37
15–16	2	134	2.4	67	33	1	111	2.1	64	36	3	130	2.3	65	35
16–17	1	116	2.2	56	45	..	...	...	..	..	1	116	2.2	56	45
17–18	..	...	...	..	..	1	115	2.0	82	18	1	115	2.0	82	18

Efforts have been made to distinguish between the protein requirement for maintenance and that for growth, but without success. As yet, we must assume that the requirements of the two are identical, and that a protein is of the same value to the child whether it is used for replacement or for construction of new tissue.

Holt and Fales, from their studies of the food eaten by 100 children of well-to-do families, obtained the figures given in Table 5. One of the interesting features of this table is the percentage of distribution of vegetable and animal protein.

Table 6 contains a summary made by Gillett[8] of the observations of several authors on a total of 146 children; and Table 7 summarizes the studies of protein intake made by Gephart[6] on the boys at St. Paul's School. The figures given by Gephart probably represent the maximum of "luxus" protein. Considering, however, every phase of nutritive efficiency, who can say that it was more than these active, growing boys needed?

TABLE 6.—*Summary of Literature on Protein Intake per Kilogram (Gillett)* *

Age, Years	Number of Cases	Total Protein Gm. Daily	Protein Intake, Average Gm. per Kilogram
2– 5	51	53	3.3
6– 9	44	67	2.6
10–13	33	73	2.0
14–17	18	94	2.2

* This table is taken from Gillett, L. H., quoted by Holt, L. E., and Fales, H. L.: The Food Requirement of Children, Am. J. Dis. Child. **22**: 371, 1921.

TABLE 7.—*Average Protein Intake in Gephart's Observations*

	Average Age		Total Protein Gm. Daily	Protein Intake Average Gm. per Kilogram
	Yrs.	Mos.		
Lower school	13	6	164	3.76
Middle school	14	7	165	3.26
Upper school	16	1	157	2.60

It is difficult to state succintly what constitutes a liberal supply of protein for the child. Until 6 years of age, he should take about 3 Gm. per kilogram of body weight of protein daily; after this the allowance should, for a time, be about 2.5 Gm. per kilogram; during the years of most rapid growth, that is, from 12 to 15 for girls and from 13 to 16 for boys, the protein intake per kilogram should be somewhat greater, say 3 Gm. or even more. Two thirds of this allowance should be in the form of animal protein, in which milk should always find a prominent place. It is safe to say always that about 15 per cent of the child's caloric intake should be in the form of protein.

Carbohydrate has functions other than merely to supply energy. It is essential to the proper metabolism of fat; the correct carbohydrate-fat ratio must be maintained in the diet if the production of fatty acids is to be avoided. It is the best protein sparer; for it has been shown that for nitrogen economy at least 50 per cent of the energy of the food must be in the form of carbohydrate. An additional advantage which carbohydrate possesses is that from a pecuniary standpoint, it is the most economical of foodstuffs.

The carbohydrate which the child takes should be largely in the form of milk, bread, cereals, potato and green vegetables. Only a small part should be eaten as sugar, syrups and sugary foods. It is interesting to learn that the studies of Holt and Fales showed that normal children take an average of 50 per cent of their carbohydrate food as sugar in some form, and that more than two thirds of these children take from 40 to 60 per cent in this form. This may be reconciled with the first statement in this paragraph by calling attention to the fact that this included not merely sugary foods, such as candy, preserves and syrups, but also the lactose of milk, the sugar of fruits and that spread on cereals. In fact, a rather large amount of it was in the form of fruits. These children averaged 10 Gm. of total carbohydrate per kilogram a day.

The objection to the use of excessive amounts of carbohydrate is that it results in a restriction of the fat and protein quotas of the diet, and causes abnormal intestinal fermentation. Another result is an accumulation of superfluous body fat, such as is seen in babies who have been reared on condensed milk and other sweetened foods. Such children are said to exhibit feeble resistance to infection.

Fat, too, has manifold functions. It is ordinarily assumed that the chief duty of this foodstuff is to bring the fuel value of the diet to the required figure, for without it it is necessary to take an amount of carbohydrate which is too bulky for comfort and good digestion. But Holt[9] and other writers ascribe to fat additional functions: it is an important carrier of the fat soluble vitamin A, which is essential to growth; and its presence in the intestinal tract (and the soap resulting therefrom) is necessary to good digestion and absorption. This author quotes the work done on calcium metabolism in the Baby's Hospital Laboratory to show that absorption takes place best when there is a liberal amount of fat in the diet. It would appear, too, that the soaps which come from these fats have an important function in preserving the normal consistency of the bowel content; lack of fat, with an overwhelming preponderance of carbohydrate, leads to fermentation, acid bowel content, and perhaps to increased susceptibility to infection. Evidently, fat has important functions in the diet of the child and should not be looked on solely as a source of energy.

In the studies made by Holt and Fales[10] on the food actually consumed by 100 normal children, it was found that more than three-fourths of these children took daily between 2 and 4 Gm. of fat per kilogram of body weight—approximately 3 Gm. per kilogram. The school-boys studied by Gephart consumed about 4 Gm. per kilogram. Thus it would appear that the child of school age should take not less than 2 Gm. of fat per kilogram of body weight, and that the extremely active boy or girl of 14 or 15 years should take more, as much perhaps as 4 Gm. per kilogram.

The *relative proportions* of the three chief foodstuffs in the child's diet, according to fuel value (calories, not grams) should be approximately as follows: protein, 15 per cent; carbohydrate, 50 per cent, and fat, 35 per cent.

The *vitamins* and *mineral salts* should not be left to chance; for children frequently exhibit developmental defects due to a diet deficient in respect to these factors. These defects include not only such well defined nutritional disorders as scurvy and rickets, but also a host of other ill defined, borderline states of malnutrition.

An excellent supply of vitamin A and a certain amount of the other vitamins may be obtained from milk. The heating of milk, as in pasteurization often destroys a part of the vitamin C, but this loss is easily made good. Vitamin B is widely distributed in nature, and unless the diet is very one-sided, this factor is not likely to be missing Vitamin C is often lacking, especially in the dietaries of asylums and other institutions, but orange juice and tomatoes (even canned tomatoes) will supply it in abundance. If the child drinks liberally of milk and eats oranges, tomatoes and green vegetables, his supply of vitamins will be adequate.

Calcium and phosphorus, particularly the former, are often lacking. The growing child requires approximately 1 Gm. of calcium daily; this element is contained in abundance in milk. Other necessary mineral elements (except iodine in the goiter districts), especially iron, which is lacking in milk, can be secured in adequate amounts from eggs and the leafy portion of green vegetables. Therefore, if the child's diet contains an abundance of milk and green vegetables, he will be assured an adequate supply of mineral elements.

The Arrangement of the Diet.—The most important food for the child is milk; it should form the basis of his diet. This warrants repeated emphasis. Too often children are allowed to become indifferent to milk or to develop an actual distaste for it and to cease drinking it. This means well nigh irreparable loss to the child. The experience of students of nutrition has shown that each child needs a quart of milk daily; the accuracy of this estimate was definitely proved by certain recently reported experiments of Sherman.[11] This may be taken in part as cocoa, or it may be made into custards and similar dishes; but, in order to secure the requisite quantity, at least some of it must be taken directly as milk. When fresh milk cannot be obtained, the dried article is entirely suitable, provided it is supplemented by orange juice. A quart of milk a day should invariably be insisted on for each child.

Cereals are excellent, especially if taken with milk. Oatmeal, rolled oats, wheatena, farina and cream of wheat are good. Those cereals which must be cooked thoroughly and long (fireless cooker) are as a rule preferable to the more expensive flaked and puffed grains. Cereals which retain a large part of the whole grain, such as whole wheat or oatmeal, are to be preferred because of their greater vitamin and mineral content. Hot breads as a rule are bad, because they are often "soggy," but well made bread which is light and porous is almost as digestible hot as cold.

Eggs are valuable food for the child. They supply proteins of high biologic value, easily digested fats, iron, and fat-soluble vitamines, especially the antirachitic factor. They should be simply prepared; soft boiled, poached, or shirred, rather than fried. One egg a day is desirable.

Meats should be permitted at first in restricted amounts. As the child grows older, he may take more, but he should never be allowed to obtain all of his protein from meat to the exclusion of milk. Meats which are simply prepared are to be preferred to the more complex croquettes and meat salads. Stews and sandwiches made from finely ground meats are suitable for children if they are not too highly seasoned. Pork, because of its high fat content should be eaten sparingly, especially by younger children.

The eating of green vegetables should be insisted on. The leafy vegetables, such as spinach, lettuce and cauliflower, are to be preferred. Peas, beans, onions, squash and asparagus are also of value; tomatoes are of especial value. Cabbage and radishes are perhaps to be avoided. The cooking of vegetables for children should be especially thorough. They should be given the water in which the vegetables are cooked as this contains valuable mineral salts and vitamins.

Fruit, either raw or cooked, should be eaten each day, but raw fruits should be full ripe. Oranges are always desirable. Ripe bananas which have begun to turn brown are valuable. They may be given even to very young children. Cooked fruits, preferably stewed, are excellent; this applies to dried as well as to fresh fruits. Baked or stewed apples and stewed prunes are especially good.

Simple desserts, preserved fruits and candy are good foods; they are not harmful if taken in moderation and at the right time. They should be eaten always at the end of the meal, for sweet things taken between meals destroy the appetite and often interfere with digestion. Pies and other pastries are as a rule indigestible because they are greasy and heavy. If well made and crisp, they need not be denied the child provided they are eaten in moderation.

The child should get his fat largely in the form of butter, cream and egg yolk. This may be supplemented by gravy taken with bread, rice or potatoes.

Simple foods are best; complex, highly seasoned dishes should be avoided. Articles which unduly stimulate the appetite are both unnecessary and harmful; they tend to destroy the natural tastes. The child should not be permitted to indulge in piquant sauces and seasonings. Salt taken in small amounts often enhances the flavor of food, but in excess destroys it; the desire for large amounts of salt is artificial and should be discouraged. Soups are not particularly good for children, because they tend to appease the appetite and thereby prevent the child from eating other needed foods. Soups should be given only once daily, and then only small amounts of cream soups. The drinking of water at meals has no disadvantage except that it may prevent the child's taking his full quota of milk. Sometimes it is of advantage to withhold water at meal times in order to induce him to take more milk.

Variety in diet should be insisted on. The child should be taught to eat of everything wholesome which comes to the table; it is a mistake, which later in life becomes a real handicap, to permit a child to develop peculiarities of taste.

Regularity of meals and lack of haste are important. The child should learn to eat with reasonable slowness and should never be permitted to hurry through his meals. Pleasant conversation and good humor at the table is as important for him as for the adult.

To Summarize.—The child of school age should have at least a quart of milk a day; a part of this may be in the form of clabber, curds with cream, custards and other dishes made with mik. Cereals with cream or milk, rice, potatoes and well cooked bread should all find a prominent place in his diet. He should have one egg daily, two if needed; and as he grows older, one helping of meat. He should have a liberal amount of fat, chiefly as butter and cream, and to some extent as bacon fat or gravy. He must have some fruit each day, raw or cooked, and two or more green vegetables, such as spinach, lettuce or cauliflower.

Regarding the total amount of food advisable, it is appropriate to quote here the conclusion drawn by Benedict and Talbot[12] from their studies of private-school children:

> But it is probable that even these children, with superior surroundings and presumably better medical examination, care, and dietetic supply, may advantageously be supplied with larger amounts of food than they at present take. One could infer, therefore, from these observations, that, aside from the possibilities of digestive derangements, it would be impossible to supply the growing child with an excessive amount of food. Every effort may legitimately be expended to secure a maximum skeletal growth and the development of children above so-called average weight. We believe that our investigation shows clearly that the average weight for children is distinctly below the ideal or physiologically desirable weight.

School Lunches.—Increasing importance is being accorded the lunch which the child eats at school. A few pupils still bring lunch, but in most instances, particularly in the cities, it is prepared at the school.

The basket lunch should be prepared with some thought as to the foods which best lend themselves to this purpose, else it may not be palatable. It should be carried in a pail or basket than can be easily cleaned, and the several articles should be separately wrapped in napkins. Foods which spoil easily should be avoided in warm weather. The thermos bottle makes it possible to carry to school the very desirable pint of milk. The following bills-of-fare for the basket lunch have been suggested by Miss Hunt:[13]

Sandwiches with sliced tender meat for filling; baked apple; cookies, or a few lumps of sugar.

Slices of meat loaf or bean loaf; sandwiches; stewed fruit; small frosted cake.

Crisp rolls, hollowed out and filled with chopped meat or fish, moistened and seasoned, or mixed with salad dressing; orange, apple, a mixture of sliced fruits, or berries; cake.

Lettuce or celery sandwiches; cup custard; jelly sandwiches.

Cottage-cheese sandwiches, or a pot of cream cheese with bread-and-butter sandwiches; peanut sandwiches; fruit; cake.

Hard-boiled eggs; baking-powder biscuits; celery or radishes; brown-sugar or maple-sugar sandwiches.

Bottle of milk; thin corn bread and butter; dates; apple.

Raisin or nut breat with butter; cheese; orange; maple sugar.

Baked bean and lettuce sandwiches; apple sauce; sweet chocolate.

Lunches *prepared at the school* are rapidly gaining in popularity. In a few instances they are prepared by the pupils themselves under competent supervision, but this is practicable only in small schools. In city schools, the lunches are as a rule provided by specially trained nutrition workers. In the Birmingham Public Schools, this work is under the general direction of the Parent-Teacher Association, but a dietitian, appointed for this purpose by the Superintendent of Schools, has immediate supervision. Each school has a properly equipped kitchen and lunch room.

The object is to serve for a few cents inviting, nutritious articles of diet. In winter a hot soup and a hot drink, such as cocoa, are always on the bill of fare. At all times emphasis is laid on the wholesomeness and great nutritional value of milk. An individual pint bottle of milk, to be taken through a straw, with a graham cracker is served for five cents. This has become popular, and the influence of example and mass psychology is such that hundreds of children who scorn milk at home, will with evident relish drink it through a straw at school.

Candies, particularly milk chocolate, are sold in the school lunch room, but the pupil is not permitted to take this as his only lunch; in many schools he cannot buy candy or chocolates until he has purchased other food.

The menus given below are served in the Birmingham Public Schools. They were prepared by Miss Bertha Clement.

Specimen School Lunches Sold in Birmingham Public Schools

One-half sandwich Banana or orange Wafer	5 cts.
Creamed potatoes Hot buttered bun	5 cts.
Butter beans Buttered bun	5 cts.
Tomatoes and spaghetti Buttered bun	5 cts.
Creamed chicken and toast Hot buttered roll and cake	10 cts.
String beans Creamed potatoes Hot corn bread Pickle Cake	10 cts.
Boiled ham Butter beans Buttered roll Cake	10 cts.
Beans Yams Corn bread	10 cts.

Creamed chicken English peas Slaw Bread or roll Wafer	10 cts.
Baked beans Slaw Buttered roll	5 cts.
Baked salmon Carrot and cabbage salad Creamed potatoes Brown bread or roll	10 cts.
Roast beef Gravy Bread	5 cts.
Rice Gravy Bread	5 cts.
Meat loaf Bread	5 cts.
Peas Corn bread	5 cts.
Butterbeans Corn bread	5 cts.

Sandwiches made of bun with cream cheese and pineapple—5 cts.

Potato salad on lettuce with crackers	5 cts.
Turnip greens Corn bread	5 cts.
Spinach and egg Baked hash Bun	10 cts.

Baked beans Bread	5 cts.
Macaroni Cheese Bread	5 cts.
Baked hash Bread	5 cts.

½ pint milk in bottle with straw and two graham crackers sold at all schools for five cents.

Mashed potatoes	5 cts.
Macaroni and cheese	5 cts.
Baked beans	5 cts.
Scalloped corn	5 cts.
Scalloped potatoes	5 cts.
Spinach	5 cts.
Green lima beans	5 cts.
Green peas	5 cts.
Scalloped tomatoes	5 cts.
Macaroni and tomatoes	5 cts.
Creamed carrots	5 cts.
Rice and cheese	5 cts.
Soup	5 cts.
Navy beans	5 cts.
Candied sweet potatoes	5 cts.
Mashed sweet potatoes with marshmellows	5 cts.
Apple and celery salad	5 cts.

Sandwiches:	
Peanut	5 cts.
Jelly	5 cts.
Cottage cheese	5 cts.
Roast beef	5 cts.
Lettuce	5 cts.
Cheese	5 cts.
Pineapple and lettuce	5 cts.
Bacon	5 cts.
Egg	5 cts.
Olive	5 cts.
Pimento cheese	5 cts.
Chipped beef	5 cts.
Raisin	5 cts.
Tomato	5 cts.
Meat loaf	5 cts.
Cheese and celery	5 cts.
Ham	5 cts.

Specimen School Lunches Sold in Birmingham Public School (Continued.)

Potato salad	5 cts.
Stewed prunes	5 cts.
Stewed apples	5 cts.
Rice pudding	5 cts.
Chocolate pudding	5 cts.
Stewed peaches	5 cts.
Tangerines	5 cts.
Apples	5 cts.
Oranges	5 cts.
Banana pudding	5 cts.
Ice cream	5 cts.
Milk	5 cts.
Lunch tongue	5 cts.

Menus for School Lunches Prepared by Irene H. Taylor, Published in Hygeia, October, 1926

CREAM OF TOMATO SOUP WITH RICE

(Serves 20)

10 cups milk
1 cup flour
½ cup butter
2 teaspoons salt
¼ teaspoon pepper
4 cups tomato juice or thin purée
¼ teaspoon baking soda
3 cups cooked rice

Make white sauce of first column of ingredients. Heat the tomato juice with the soda till it boils. When ready to serve, combine with the white sauce, and add the cooked rice and the rice water. Season to taste.

CREAMED DRIED BEEF ON TOAST

(Serves 50)

6 quarts white sauce
2 pounds shredded dried beef
3 beaten eggs
50 slices toast

Frizzle the dried beef in a little fat, add it to the white sauce, bring to boil, stir in the beaten eggs and serve immediately on toast.

CREAMED EGGS AND POTATOES

(Serves 25)

20 hard-cooked eggs, sliced or halved
10 cups cold diced potatoes, cooked
2 quarts white sauce
¼ cup chopped parsley, in season

Combine eggs and potatoes with the white sauce, season to taste, heat thoroughly, serve with parsley on top.

LAMB A LA KING

(Serves 60)

10 pounds cooked shoulder of lamb, diced
2 gallons skim milk, 1 pound butter, 1 pound flour, ¼ pound cornstarch
3 minced green peppers
1 red pepper, minced

Make white sauce of milk, fat, flour and corn starch; add diced cooked lamb and the diced peppers. Season to taste.

Heat thoroughly; serve on toast.

HAM AND NOODLES

(Serves 70)

5 pounds noodles, cooked in boiling salted water and drained
1 pound butter or margarine to season noodles
1½ loaves bread for toast
6 pounds diced cooked ham

Season the noodles, and place a serving of them in a soup bowl.

Place a good-sized spoonful of the diced ham on top of them, then lay a triangle of toast on the ham.

Mask the whole with a well seasoned gravy of white sauce, or chicken stock if available.

CORN CHOWDER

(Serves 45)

4 1½-inch cubes salt pork
4 sliced onions
12 cups diced potatoes, parboiled in 1 quart water for five minutes
4 quarts scalded milk
¾ cup butter or oleomargarine
½ cup flour
4 cans corn (No. 2 cans)
salt and pepper to season

Cut salt pork into small pieces and fry out, add onions and cook five minutes. Add the potatoes and the water in which they were parboiled and cook, covered, till tender. Add corn, seasoning, ½ cup diced celery if available, and the white sauce made from the milk, fat and flour. Cook slowly over low fire until thoroughly heated. Serve with crackers.

SCOTCH LAMB BROTH

(Serves 25)

Six pounds lamb shank and neck, simmered in 4 quarts water till tender. After first hour of cooking add 6 cups diced raw potatoes, 1 cup diced carrots, ½ cup carrots ground in food chopper, 2 sliced onions and 1 cup pearl barley. Cook another hour. If too fat, skim some of it off. Season and serve with crackers.

Nutrition classes for all children who are underweight to the extent of 10 per cent or more are conducted in certain schools. These pupils are taught the value of milk and other good food as well as of good hygiene. A graphic chart is kept of each child's gain in weight, and great rivalry is stimulated. It has been found that the value of the nutrition class extends far beyond its immediate members; the gospel of good food spreads throughout the entire school, and in those schools where nutrition classes are held, the per capita consumption of milk materially exceeds that of the other schools. It is evident that the parents, too, are reached, and that the influence of the nutrition class reaches even the community at large.

TABLE 8.—*Weight-height-age Table for Boys of School Age*

WEIGHT-HEIGHT-AGE TABLE FOR BOYS OF SCHOOL AGE

Height (inches)	Average weight for height (lbs.)	5 Years	6 Years	7 Years	8 Years	9 Years	10 Years	11 Years	12 Years	13 Years	14 Years	15 Years	16 Years	17 Years	18 Years	19 Years	Height (inches)
38	34	34	34*														38
39	35	35	35														39
40	36	36	36*														40
41	38	38	38	38*													41
42	39	39	39	39*	39*												42
43	41	41	41	41*	41*												43
44	44	44	44	44	44*												44
45	46	46	46	46	46*	46*											45
46	48	47*	48	48	48	48*											46
47	50	49*	50	50	50	50*	50*										47
48	53		52	53	53	53	53*										48
49	55		55	55	55	55	55	55*									49
50	58		57*	58	58	58	58	58*	58*								50
51	61			61	61	61	61	61	61*								51
52	64			63	64	64	64	64	64	64*							52
53	68			66*	67	67	67	67	68	68*							53
54	71				70	70	70	70	71	71	72*						54
55	74				72*	72	73	73	74	74	74*						55
56	78				75*	76	77	77	77	78	78	80*					56
57	82					79*	80	81	81	82	83	83*					57
58	85					83*	84	84	85	85	86	87					58
59	89						87	88	89	89	90	90	90				59
60	94						91*	92	92	93	94	95	96				60
61	99							95	96	97	99	100	103	106*			61
62	104							100*	101	102	103	104	107	111	116*		62
63	111							105*	106	107	108	110	113	118	123	127*	63
64	117								109	111	113	115	117	121	126	130*	64
65	123								114*	117	118	120	122	127	131	134	65
66	129									119	122	125	128	132	136	139	66
67	133									124*	128	130	134	136	139	142	67
68	139										134	134	137	141	143	147	68
69	144										137	139	143	146	149	152	69
70	147										143	144	145	148	151	155	70
71	152										148*	150	151	152	154	159	71
72	157											153	155	156	158	163	72
73	163											157*	160	162	164	167	73
74	169											160*	164	168	170	171	74

Age—years		6	7	8	9	10	11	12	13	14	15	16	17	18	19
Average height (inches)	Short	43	45	47	49	51	53	54	56	58	60	62	64	65	65
	Medium	46	48	50	52	54	56	58	60	63	65	67	68	69	69
	Tall	49	51	53	55	57	59	61	64	67	70	72	72	73	73
Average annual gain (lbs.)	Short	3	4	5	5	5	4	8	9	11	14	13	7	3	
	Medium	4	5	6	6	6	7	9	11	15	11	8	4	3	
	Tall	5	7	7	7	7	8	12	16	11	9	7	3	4	

* This table is taken from Baldwin, Bird T., and Wood, Thomas D., Mother Child, American Child Health Assoc. Supplement to July, 1923, issue.

TABLE 9.—*Weight-height-age Table for Girls of School Age*

WEIGHT-HEIGHT-AGE TABLE FOR GIRLS OF SCHOOL AGE

Height (inches)	Average weight for height (lbs.)	5 Years	6 Years	7 Years	8 Years	9 Years	10 Years	11 Years	12 Years	13 Years	14 Years	15 Years	16 Years	17 Years	18 Years	Height (inches)
38	33	33	33													38
39	34	34	34													39
40	36	36	36	36*												40
41	37	37	37	37*												41
42	39	39	39	39*												42
43	41	41	41	41	41*											43
44	42	42	42	42	42*											44
45	45	45	45	45	45	45*										45
46	47	47*	47	47	48	48*										46
47	50	49*	50	50	50	50	50*									47
48	52		52	52	52	52	53*	53*								48
49	55		54	54	55	55	56	56*								49
50	58		56*	56	57	58	59	61	62*							50
51	61			59	60	61	61	63	65							51
52	64			63*	64	64	64	65	67							52
53	68			66*	67	67	68	68	69	71*						53
54	71				69	70	70	71	71	73*						54
55	75				72*	74	74	74	75	77	78*					55
56	79					76	78	78	79	81	83*					56
57	84					80*	82	82	82	84	88	92*				57
58	89						84	86	86	88	93	96*	101*			58
59	95						87	90	90	92	96	100	103*	104*		59
60	101						91*	95	95	97	101	105	108	109	111*	60
61	108							99	100	101	105	108	112	113	116	61
62	114							104*	105	106	109	113	115	117	118	62
63	118								110	110	112	116	117	119	120	63
64	121								114*	115	117	119	120	122	123	64
65	125								118*	120	121	122	123	125	126	65
66	129									124	124	125	128	129	130	66
67	133									128*	130	131	133	133	135	67
68	138									131*	133	135	136	138	138	68
69	142										135*	137*	138*	140*	142*	69
70	144										136*	138*	140*	142*	144*	70
71	145										138*	140*	142*	144*	145*	71

Age-Years		6	7	8	9	10	11	12	13	14	15	16	17	18
Average Height (inches)	Short	43	45	47	49	50	52	54	57	59	60	61	61	61
	Medium	45	47	50	52	54	56	58	60	62	63	64	64	64
	Tall	47	50	53	55	57	59	62	64	66	66	67	67	67
Average Annual Gain (lbs.)	Short	4	4	4	5	6	6	10	13	10	7	2	1	
	Medium	5	5	6	7	8	10	13	10	6	4	3	1	
	Tall	6	8	8	9	11	13	9	8	4	4	1	1	

* This table is taken from Baldwin, Bird T., and Wood, Thomas D., Mother Child, American Child Health Assoc. Supplement to July, 1923, issue.

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CHAPTER IX

THE FEEDING OF INFANTS

McKim Marriott, M. D.

Washington University, St. Louis

NORMAL INFANTS

The food requirements of the infant are greater proportionately than those of the adult, the normal infant requiring approximately three times as many calories per pound of body weight as a grown man doing a moderate amount of work. At the same time, the infant's digestive capacity is limited, and unless the food supplied is one readily digestible, the limits of digestion may be exceeded and more or less serious disturbances result. The infant is incapable of choosing his own food, is compelled to take what is given to him, and, when well, usually takes any food offered, whether suitable or unsuitable until the stomach is confortably filled. Furthermore, such bacteria as may be introduced along with the food are likely to flourish in the intestinal tract of the infant and thus bring about more or less serious gastro-intestinal disturbances.

If one has a knowledge of the total food requirements and of the digestive capacity during infancy, infant feeding becomes a relatively simple matter, but only too often the total food offered is insufficient for the needs of the infant or is lacking in some essential constituent, is contaminated by bacteria or is of a type incapable of digestion.

The essential qualifications of any successful feeding of an infant are as follows: (1) sufficient calories; (2) sufficient protein, carbohydrate, mineral salts, water and the four vitamins, A, B, C, and D (fat and pigment are desirable but not absolutely essential); (3) relative freedom from harmful bacteria, and (4) digestibility. Any food offered an infant should be carefully scrutinized in order to determine whether all of the foregoing requirements have been met, as failure to meet any one of them introduces a weak link in the chain, and a successful nutritional result is impossible.

The total quantity of food required by the normal infant during the first year of life averages 110 calories per kilogram (50 calories per pound) a day. During the first four months of life, the requirement is somewhat greater than during the latter part of the first year. It may be as high as 120 calories at one month of age and from 80 to 90 calories at the age of 1 year. The caloric requirements of infants who are underweight are relatively greater than those of normal or overweight infants. For example, an undernourished infant weighing 10 pounds at the age of 6 months would require approximately as much total food as a normal infant of the same age weighing 15 pounds; this would of course be more per pound. In calculating the approximate caloric requirement of an individual infant, one should first determine the *expected* or normal weight for the age and attempt to give 110 calories per kilogram (50 calories per pound) on the basis of this, rather than on the *actual* weight. On this basis some very small infants may receive as much as 200 or 300 calories per kilogram (100 or 150 calories per pound).

The average total caloric intake of normal infants at various ages is approximately as given in Table 1.

TABLE 1.—*Average Caloric Intake of Normal Infants*

Age	Calories
1 month	400
2 months	450
4 months	600
7 months	750
1 year	850

REQUIREMENT OF VARIOUS KINDS OF FOOD

Protein.—The protein requirement of infants is fairly high because of the need for building up new tissue. The protein of human milk is of higher biologic value than that of cow's milk. From 2 to 2.5 Gm. of protein per kilogram of body weight a day is sufficient when human milk is fed, but from 3 to 3.5 Gm. of protein is advisable when cow's milk is given. The total amount of protein in cow's milk and breast milk is also different, being 3.5 per cent in cow's milk and 1.25 per cent in breast milk. An optimum amount of protein for the normal infant is supplied when he receives one-tenth of his body weight in cow's milk a day (1.5 ounces per pound of body weight) or one-seventh of his body weight in breast milk (2.5 ounces per pound of body weight). Under-nourished infants require relatively more protein per pound than those who are normal. Insufficient protein in the diet leads to slow growth, lack of resistance to infection and at times to a "nutritional edema."

Carbohydrate.—In the case of young infants the carbohydrate taken is entirely in the form of sugar, either the lactose in the milk or added sugar of some form. After 6 months of age, extra carbohydrate in the form of starch may be supplied to advantage. Human milk contains so much carbohydrate that no additional sugar need be added during early infancy in the case of breast-fed infants, but when cow's milk is fed additional sugar is given, the proportion being about one part of sugar to ten parts of milk, the total carbohydrate taken in a day being about 10 Gm. per kilogram (0.15 ounce per pound of body weight); this figure includes both the sugar of the milk and the added carbohydrate. An excess of carbohydrate in proportion to the milk in the diet should be avoided, the ratio of one part of sugar to ten of cow's milk being about as much as should be given. When the proportion of carbohydrate is too high the intake of the other constituents of milk—protein, fat and salts— is decreased and the nutrition suffers. For example, the proportion of sugar in sweetened condensed milk is so high that when the caloric requirements are met by the feeding of such a diet, an insufficient amount of milk is taken, no matter what the degree of dilution or concentration adopted. On the other hand, there is little danger of overfeeding with sugar if sufficient milk is given so as to balance the diet.

A number of sugars are suitable for addition to milk formulas. Milk sugar or lactose has been extensively used but possesses no advantages over the cheaper cane or beet sugar. Mixed sugars of the "malt" type prepared by the hydrolysis of starch by malt diastase or by acids are especially suitable for routine use in the feeding of infants. These "sugars" are mixtures of dextrin, glucose and maltose. They are readily digested and assimilated, do not have a marked laxative effect and are not excessively sweet. They can often be fed safely in larger amounts than can either cane or milk sugar. Mellin's Food, Mead's Dextrimaltose, Borcherdt's Malt Sugar and Karo Corn Syrup are the most used forms of "malt sugar." Karo syrup is the cheapest and the most generally serviceable of the group.

Starch in the form of well cooked cereal gruels made from barley flour, farina or oatmeal should be added to the diet of most infants from the age of 6 months on. Oatmeal gruels should be strained before feeding to infants under the age of 1 year. Starch may be fed with safety even to very young infants, and is often used to thicken milk mixtures for infants who vomit. The digestion of starch is incomplete during early infancy, but the capacity for starch digestion increases when starch is fed regularly. The undigested starch which passes through the intestinal tract rarely seems to cause trouble.

Fat.—The fat of milk supplies approximately one-half of the total calories of the milk. It also contains the fat-soluble vitamins A and D.

A certain amount of fat is therefore desirable in the diet of the infant. An excess of fat, particularly the fat of cow's milk, must be avoided, as the lower fatty acids present are irritating to the gastro-intestinal tract. The amounts of fat in either human milk or ordinary whole cow's milk is within the digestive capacity of most infants, provided the amounts of milk fed do not greatly exceed that recommended above. Milk from Jersey or Guernsey cows contains such a high proportion of fat as to render it unsuitable for many infants. Cream or top milk should not be used for the feeding of infants.

Mineral Salts.—With the exception of iron, the mineral salts are supplied in sufficient amounts when the infant receives the quantities of breast milk or cow's milk mentioned above under protein requirements.

Water.—The infant's water requirement is from 10 to 15 per cent of the actual body weight a day. Most of the water requirement is met when the quantities of milk already mentioned are fed, but during warm weather additional water should be offered between feedings.

Vitamins.—A baby receiving the amounts of cow's milk or breast milk mentioned above receives a sufficient quantity of the A and B vitamins but not necessarily enough of the C and D vitamins. During the winter months, all babies should receive from one-half to one teaspoonful of cod liver oil three times a day to supply the antirachitic or D vitamin. During the summer, if the baby is exposed to sunlight, the amount of cod liver oil may be diminished or may be entirely omitted. Artificially fed babies should receive from one to two tablespoonfuls of orange juice or tomato juice daily from the first or second month on in order to supply the C or antiscorbutic vitamin.

Pigment.—The pigment contained in green vegetables may be utilized to build up hemoglobin. Infants given purees of green vegetables from the sixth month on are less likely to suffer from anemia than those receiving only milk. One tablespoonful of puree of spinach once a day after the sixth month supplies sufficient pigment as well as iron for the infant's needs.

Bacterial Contamination of Milk.—This is a frequent cause of gastro-intestinal disturbances in infants. The bacteria in question may be definitely pathogenic or may be saprophytic, but capable of producing irritating products in the intestinal tract. Mother's milk is usually free from bacterial contamination, but all cow's milk fed to infants should be boiled and kept under such conditions that bacterial contamination will not subsequently occur. The boiled milk may subsequently be soured by the addition of acid or by pure cultures of lactic acid producing organisms, and such milk is less susceptible to bacterial contamination than is sweet milk.

Digestibility of Milk.—Human breast milk is more digestible than cow's milk. If a normal infant nurses the mother's breast at reasonable intervals (every three to four hours) the amount of milk taken will not ordinarily exceed the digestive capacity of the infant. Cow's milk, however, is not so digestible. There are several reasons for this. The fat is of somewhat different character. The curds are larger and tougher, but perhaps of greatest importance is the fact that the cow's milk contains a large amount of "buffer substance" capable of neutralizing the gastric juices of the infant. Cow's milk which has been artificially soured with lactic acid (see below) so as to neutralize the buffer substance and render the milk more digestible may be given in the same amounts as breast milk, with safety, and such milk need not be diluted. When an infant is given undiluted sweet cow's milk, however, up to the limits of his stomach capacity, there is a possibility that the amount may be beyond his digestive ability. Dilution of the milk results in the infant's taking a smaller total amount of milk, even though he takes as much as his stomach will hold. Sweet milk should, therefore, be diluted in the case of infants with limited digestive capacity, although a certain number of normal infants are able to take sweet milk undiluted up to the point of satisfying the appetite. The object of dilution is not to lower the percentages of any particular constituent, but merely to insure the taking of a somewhat smaller amount of milk at each feeding. The same result might be accomplished by offering a smaller total quantity of undiluted milk, but normal well infants are usually more comfortable and better satisfied when the stomach is filled at each feeding.

BREAST FEEDING

The essential qualifications for a successful diet as outlined above are adequately met when the infant receives milk from a healthy mother. Human milk contains all the necessary food elements. Its caloric value is such (20 calories to the ounce) that when the infant is fed at reasonable intervals and takes as much as he desires, the total energy requirements are met. There is little danger of underfeeding or overfeeding, provided the mother's supply of milk is adequate. Milk nursed directly from the breast is free from harmful bacteria and is readily digested. It has been claimed that breast milk contains certain protective substances which are of value in rendering the infant resistant to infections. The milk from an ignorant but healthy mother is more likely to meet all the essential qualifications than an artificial formula prescribed by a physician and prepared in a high class home or milk laboratory.

Breast milk is of especial value during the first few weeks of life when the infant's digestive capacity is small and he is susceptible to intestinal infections. Breast feeding should be encouraged, particularly among the poor and ignorant, and among all classes during the warmer seasons of the year. Many infants are unnecessarily weaned because of minor complaints. The milk of a healthy mother almost invariably agrees with the baby, provided the milk is sufficient in quantity and the baby is nursed at the proper intervals. If an infant does not do well on the milk of a normal mother, it is likely to fare worse still on artificial feeding. On the other hand, it is not advisable to allow a baby's nutrition to suffer when the mother obviously has an insufficient supply of milk, or to urge a delicate mother, having a scanty supply of milk, to nurse a baby who is in good health and capable of thriving on an artificial formula.

There are certain definite contraindications to an infant nursing its mother. No baby should nurse a mother with active pulmonary tuberculosis, nor should the infant be brought into any contact with the mother. Severe chronic illnesses on the part of the mother are contraindications for nursing. Acute illnesses or surgical operations call for temporary weaning, the breasts being pumped out manually or by the use of a breast pump until convalescence is established, at which time the infant may be returned to the breast. Syphilis in either the mother or the baby is not a contraindication to nursing.

Technic of Breast Feeding.—The baby should be placed at the breast in from six to twelve hours following delivery and every six hours during the next twenty-four hours. The breasts should be alternated. Beginning on the third day, the infant should be placed at the breast every four hours. Very little milk is obtained by the infant for the first few days, but the nursing stimulates the breasts to secrete and is, therefore, of importance. The colostrum which is secreted during the first few days is probably of value. As the infant receives so little milk during this time, he should be given water, or preferably a 5 or 10 per cent solution of cane sugar or corn syrup from a bottle or medicine dropper immediately after each nursing. About the third day or fourth day the sugar may be omitted. If the milk has not "come in" satisfactorily by that time, the infant should be permitted to nurse both breasts at each nursing, and if a sufficient amount of milk is not obtained in this way, a cow's milk formula should be given from a bottle following each nursing.

Most infants do best when fed at four hour intervals. Convenient hours are 2, 6 and 10 a. m., and 2, 6, and 10 p. m. At the end of a month, the 2 a. m. feeding can often be omitted, provided the infant is gaining well; otherwise, it should be continued. Babies who are accustomed to the 2 a. m. feeding will sometimes awaken and cry if the feeding is omitted, but water given from a bottle often serves to satisfy the infant.

When the mother's milk is scanty, it is advisable to have the baby nurse at three hour intervals, giving seven feedings a day. The total amount of milk obtained in twenty-four hours is sometimes greater on a three hour interval, but in many instances, after maintaining the three hour interval for a short while, the milk supply becomes sufficient so that the four hour schedule may be resumed. The advantages of the four hour interval are that the infant's digestive tract has more opportunity for rest, the stomach is more completely emptied and there is generally less vomiting. Furthermore, at the end of four hours the baby is more hungry than at the end of three hours and nurses the breasts more vigorously. An additional advantage of longer feeding intervals is that the mother is able to be away from the baby for longer periods of time, and thus her activities are less restricted.

A feeding schedule once adopted should be adhered to regularly. The infant should be awakened at the feeding time. Occasionally, however, infants on a four hour interval may become very hungry at the end of three and one-half hours. Under these circumstances, the infant should not be allowed to cry for the remaining half hour, but should be fed. The following feeding, however, should be at the regular hour. It is very easy for a mother to get in the habit of feeding a baby every time he cries, and to make the feeding intervals shorter and shorter. Babies with irregular habits are likely to be crying, fussy and colicky, and the mother who feeds her baby whenever he cries becomes tired out and generally unfit to nurse or care for her child.

In most instances the supply of milk is abundant enough so that the infant may obtain sufficient from a single breast, and it is desirable to offer alternate breasts, one at each nursing. By satisfying the infant at one breast, that breast is more thoroughly emptied, and the production of milk is encouraged. Often when both breasts are given at a single nursing, the infant is overfed, which results in intestinal disturbance and discomfort. If the supply of milk is insufficient, both breasts may be given at a single nursing.

The average nursing time for an infant at the breast is about fifteen to twenty minutes. This depends on the sucking strength of the infant, the amount of milk available and whether the breasts are easy or difficult to empty. Some infants will obtain sufficient milk and be satisfied in ten minutes or less, but if an infant nurses longer than thirty minutes there is something wrong. The milk may be insufficient or the baby feeble or some other difficulty may be found. On the other hand, a very short nursing period does not necessarily mean that the infant has had enough. If there is little milk, he may give up quickly and may either cry or fall asleep. The flow of milk is much more rapid during the first period of a nursing than it is later, so much so that an infant obtains more than half of the total quantity in the first five minutes, more than one-quarter in the next five minutes and a very little after this time. Many infants who remain at the breast for long periods of time swallow air in considerable amount, and this leads to vomiting, colic and fretfulness. Every infant swallows some air, and for this reason it should be the custom to hold the baby over the shoulder and pat him on the back until such air is belched up. This should be done before and after each feeding.

The Abnormal Breast-fed Infant.—Infants nursed at the breast usually do well, provided the mother has a sufficient supply of milk and the baby is fed at proper intervals. Failure to do well is more likely to be due to the presence of infection or to congenital anomalies on the part of the infant than to the character of the feeding.

Certain breast fed infants, however, fail to receive a sufficient amount of milk from the mother and are consequently underfed. The symptoms of underfeeding depend on the degree of deficiency of the diet. There may be a small gain, no gain or an actual loss in weight. The total volume of the stools passed in a day is small, but the individual movements may be frequent and green, though they contain relatively little food material. The diarrhea of starvation is often mistaken for that of overfeeding. Underfed infants are fretful, cry a great deal and often suffer from colic. In fact, contrary to the usual belief, colic is more frequently due to underfeeding than to any other cause. The underfed baby sucks his fingers and anything he can get to his mouth. He consequently swallows a great deal of air and often vomits from this cause.

In order to determine definitely whether or not the symptoms are due to underfeeding, the actual amount of milk obtained should be ascertained. This is done by weighing the infant before and after nursings. The infant should be weighed with the clothes on and nothing changed between the two weighings. The weight of the milk obtained at a single nursing gives very little information, as the infant gets widely varying amounts at different nursings. The quantity obtained at several nursings should be averaged, or, better still, the total amount nursed in twenty-four hours should be determined.

The mother may secrete sufficient milk, but the baby may be unable to obtain it because of inverted nipples, in which instance a nipple shield may be used, or the breast emptied by mechanical means. Complete emptying of the breast by mechanical means following each nursing serves as a stimulus to further secretion. If, despite all efforts, the amount of milk obtained by the baby is insufficient for his needs, the feeding should be complemented by a cow's milk formula given immediately after the nursing, but the infant usually should not be weaned during the first few months of life unless the breast milk supply is so inadequate as to cover less than 25 per cent of the total requirements. There is not the same objection to weaning in the case of older infants.

If an infant is nursing at intervals of four hours, there is little danger of overfeeding. Occasionally a mother has an abundant supply of milk which flows readily, and the infant gorges himself at each feeding. Infants 2 or 3 months of age have been known to take as much as from 8 to 10 ounces of milk at a single nursing. As a result, a portion of the milk is likely to be regurgitated, or there may also be occasional loose stools. The remedy is simple and consists in shortening the length of time that the baby nurses. Some strong infants get sufficient milk for their needs at the end of from three to five minutes.

A mother's milk rarely, if ever, disagrees with her baby. It may be deficient in quality, or the baby may fail to do well because of irregular nursing. Breast milk varies in its fat content, but this variation is not usually sufficient to render the milk unsuitable for the baby, although in some instances the fat content is so low that the infant must take a large total volume of milk in order to receive sufficient calories.

Diarrhea and severe vomiting in breast-fed babies is usually due to the presence of some infection, such as otitis media or pyelitis; babies with pyloric stenosis vomit whether fed on the breast or artificially. A serious and frequently made mistake is to wean a baby who is vomiting because of pyloric stenosis.

Additions to Breast Feeding.—Breast milk supplies all the necessary components of the diet of a young infant, but as the infant becomes older he requires extra food. The baby exclusively breast fed after 6 months or 1 year of age is likely to be flabby and anemic because of the relatively small amount of protein and iron in milk. From the age of 6 months a nursing infant should be given daily purees of green vegetables, meat broths and cereals. When the breast feeding is supplemented in this way, the infant may be nursed well into the second year, but there is no particular advantage in the case of normal infants in prolonging the nursing period beyond one year. Infants, however, should not be weaned during a period of illness or during the warmer months of the year if it can be avoided.

Gradual weaning is to be preferred. At first a single bottle is substituted for a breast feeding, and gradually the number of bottles in the day is increased. It is not always possible to wean a baby in this way, as the infant may obstinately refuse the bottle. In such cases it is sometimes necessary to starve the infant into submission, withholding all feeding except the bottle. A baby will sometimes refuse to take food from a bottle if offered to him by the mother because he expects to get the breast; a stranger may be more successful in persuading such babies to take the bottle.

THE ARTIFICIAL FEEDING OF NORMAL INFANTS

All of the requirements previously outlined may be met satisfactorily by the use of mixtures of cow's milk and sugar, together with such additional articles of diet as cod liver oil, orange juice, cereal and green vegetables.

Cow's milk forms the basis of the diet. Mixed herd milk from Holstein cows is preferable to the milk from a single cow or milk from Jersey or special breeds. Pasteurized milk should be used when available, but if not, milk coming from a clean dairy and delivered promptly after milking should be selected. The formula for an entire day should be made up as soon as possible after the milk is received. In the table below is given the approximate proportions of milk, sugar and water for the feeding of an average normal infant.

Expressing the formulas in a different way, one may select as a standard formula one part of sugar to ten parts of milk. (Three ounces of sugar to the quart of milk.) The standard formula is diluted with an equal volume of water for infants under 1 month of age, with

TABLE 2.—*Outline for the Feeding of Normal Infants with Whole Sweet Milk Mixtures*

Age	Whole Milk, Ounces	Diluent, Ounces	Sugar, Ounces	Feedings, Ounces
1 week	6	6	1	6 × 2
2 weeks	10	8	1	6 × 3
1 month	14	10	1¼	6 × 4*
3 months	18	7	1½	6 × 5
4 months	22	8	2	5 × 6†
6 months	26	9	2	5 × 7
8 months	32	0	1	4 × 8
12 months	32	0	0	4 × 8

* In all cases the formulas given in the table are to be supplemented with orange juice and cod liver oil from the first month on.

† Cereals, green vegetables and meat broths are added at the age of 6 months.

half the volume of water at 2 or 3 months; thereafter the water is gradually reduced until none is added by the eighth or ninth month. In some infants with good digestion all water may be omitted from the formula much earlier. After cereals are added to the diet, the amount of sugar may be reduced gradually until only 1 ounce to a quart of milk is added.

The formulas given need not be followed literally. If a baby does not gain at the normal rate and seems hungry, the amounts at a feeding should be increased. It is usually an advantage to offer, in each bottle, more milk than the average amount taken at a feeding, allowing the baby to leave part of the formula if not especially hungry or to take it all when the appetite is increased. This tends to duplicate conditions existing when the infant nurses at the breast. There is little danger of overfeeding under such circumstances, provided the formula is of the type advised, the feeding intervals are long and the hole in the nipple not so large that the food is gulped down rapidly.

Ordinarily not more than six feedings a day are given, and only exceptionally should the feeding intervals be shorter than every four hours. It will be found that some babies become hungry at the end of three to three and one-half hours. In such instances the individual feedings may be increased or water left out so as to make the feedings more concentrated. If the baby still continues to be hungry before the expiration of the four hour interval, he may be fed more frequently, but never more frequently than every three hours. It is only rarely that it is necessary to feed a baby at intervals shorter than four hours. As soon as the baby will sleep through the night, one or two feedings may be omitted.

In preparing a formula, the sugar is first measured out and mixed with the water. Brown Karo corn syrup is the sugar of choice, but cane sugar may be substituted. In measuring out the Karo syrup, 1 ounce by volume or two level tablespoonfuls contains 1 ounce of sugar. As the syrup is thick and sticky and does not flow readily, it is an advantage to dilute the syrup by mixing it with an equal volume of water and to use 2 ounces of this thin mixture in place of 1 ounce of the thick. The 50 per cent Karo syrup solution does not keep well unless it is placed on ice, and not more than 1 pint at a time should be prepared. When cane sugar is used, two level tablespoonfuls equal 1 ounce by weight.

The milk is added to the mixture of sugar and water and the whole is brought to a boil in a sauce pan or heated in a covered double boiler for twenty minutes after the water in the lower portion begins to boil. While the milk is still hot it should be poured into clean nursing bottles, one for each feeding. The scum should be strained off through a sterilized tea strainer. The bottles are stoppered by sterile nonabsorbent cotton or sterile corks and cooled by immersion in cold water and kept in a refrigerator until used.

An alternate method of preparing the formulas is to fill the bottles, stopped with cotton and place in a rack containing a few inches of water. The bottles remain for thirty minutes from the time the water begins to boil.

The caloric value of the formulas is readily calculated, the following figures being used: milk, 20 calories per ounce; sugar, 120 calories per ounce.

Technic of Feeding.—The bottles should be warmed to body temperature by immersion in warm water. The hole in the nipple should be of such size that the milk drops readily but does not flow in a stream. A small hole may be enlarged by burning with a hot wire. The bottle should be held for the baby throughout the feeding. Any milk left in the bottle should be discarded and not given to the baby later. After each feeding the infant should be held over the shoulder and patted on the back in order to cause the belching of swallowed air. It may be necessary to hold an infant for as long as fifteen minutes to accomplish this.

VARIOUS ARTICLES OF FOOD

The Use of Lactic Acid Milk Mixtures.—As already mentioned, sweet cow's milk is not as digestible as breast milk. Its digestibility, however, is greatly improved by the addition of acid, preferably lactic acid. Milk so prepared keeps well even in the summer weather, is not likely to become contaminated by harmful bacteria and is much less likely to produce diarrhea than is sweet milk. For most infants lactic acid milk formulas are advised even though the infant can be satisfactorily fed on sweet milk mixtures.

Whole lactic acid milk is prepared by dairies in all of the larger cities. It is made by treating pasteurized milk with cultures of acid-producing organisms. It can be prepared in the home as follows:

An active culture is first made by adding one of the stock cultures on the market (tablet or liquid) to a few ounces of sterilized milk. This is incubated until sour. As some stock cultures are inactive, it is important first to make an active culture in this way in order to have a culture known to be efficient. One tablespoonful of this culture is added to a quart of sterilized or pasteurized milk warmed to incubator temperature. This is then set aside for about twelve hours in a warm place. A convenient method of keeping the milk warm is to transfer it to a "Thermos" bottle.

If the milk is incubated too long or at too high a temperature or if it is contaminated with certain bacteria, it may have an unpleasant rancid odor, be filled with bubbles, or the curds may separate from the whey in large lumps. Such milk is not suitable for infant feeding.

It has been found that milk soured by the addition of acid is just about as suitable for infant feeding as that soured by bacterial action. A satisfactory lactic acid milk can be prepared as follows: One quart of cold pasteurized or boiled milk is placed in a bowl and 1½ drams (6 cc.) of U. S. P. lactic acid (75–85 per cent) is added, drop by drop, while the milk is stirred. The first half of the acid may be added rapidly, but the remainder must be added slowly. Agitating for a few minutes with a Dover egg beater after the addition of acid is advantageous in breaking up the curd, but is not essential. *It is important that the milk should be thoroughly cold before the acid is added.*

When boiled milk is used, the milk should be boiled for two minutes over a flame or heated in a covered double boiler for ten minutes after the scum starts to form, but it must be thoroughly cooled before adding the acid. The milk prepared by the addition of acid closely resembles that produced by the natural souring of milk, but it is not quite as smooth and there is more of a tendency for the curds to separate on standing. It has an acid taste and odor. Lactic acid milk may also be obtained in dried form (The Merrell Soule Co., Meade Johnson & Co.). Such milk keeps readily, and when added to the proper amount of water, provides a satisfactory product for infant feeding.

In feeding lactic acid milk mixtures, it is not necessary to sterilize the mixture after making up. In preparing the bottles for feeding, they should be warmed to body temperature but not heated to a high temperature as this will cause coagulation. As the mixtures are very thick, the holes in the nipples must be considerably larger than when sweet milk is fed.

In feeding lactic acid milk formulas, practically the same formula is given throughout the first year. The formula during the first six months is prepared by adding one part of the Karo Syrup to ten parts of lactic acid milk (3 ounces to the quart of milk). From the sixth to the ninth month, the proportion is 2 ounces of the syrup to the quart of milk. The caloric value of milk with 10 per cent added Karo syrup is 30 calories to the ounce or 1,000 calories per liter.

In feeding the mixture recommended, the infant is fed every four hours and given such amounts as he will take readily. As the feeding is a concentrated one, containing a large number of calories, most infants receive enough food in four feedings a day after the first month or two, and a few infants are able to get along well on only three feedings a day. The additional foods, such as cereal and vegetable purees, orange juice and cod liver oil should be added to the diet in the same way as when feeding sweet milk mixtures.

The Use of Special Milks.—Evaporated milk is whole cow's milk evaporated to one half of its volume and sterilized in cans. Such milk is bacteria-free, but does not keep well after the can is opened. On account of the thorough cooking, it is more digestible than fresh milk. The content of vitamin C is very low, but this vitamin may be supplied by orange juice. The taste of evaporated milk is different from that of sweet milk, but most babies will take it readily. Unsweetened evaporated milk is a satisfactory form of milk to use when good fresh milk is not obtainable, or when there are no good facilities in the home for keeping milk cold.

In making up sweet milk formulas from evaporated milk the same outline is followed as that already given except that half as much of the concentrated evaporated milk is used and the volume is made up with water. In using unsweetened evaporated milk, it is often an advantage to use the small 4 ounce cans, opening a fresh can for each feeding. These cans are cheap, obtainable everywhere, and the formula can be made up when needed and requires no further sterilization.

Lactic acid milk mixtures may also be made readily from unsweetened evaporated milk. The method of preparation is as follows: a stock solution of Karo syrup and lactic acid is prepared according to the following formula:

Stock Solution

Brown Karo Syrup	6 ounces
Lactic acid, U. S. P. (75–85 per cent)	2.5 drams
Water to	1 quart

The syrup is dissolved in the water, and then the acid is added. The mixture should, if convenient, be kept in a cool place, but on account of its high acid content, it keeps perfectly for several days, even at ordinary temperatures.

In making up the feedings, equal parts of unsweetened evaporated milk and the "stock solution" are mixed. This is done by first pouring the milk into the feeding bottle and then adding the stock solution. The mixture is shaken, and after warming to body temperature is ready for feeding. An entire day's feeding may be made up at one time, or as is often more convenient when traveling, a single small can of evaporated milk may be opened fresh for each feeding.

Dried Milk.—A satisfactory method of preparing milk is to dry it to a powder. There are several forms of dried milk on the market. "Klim" is made from whole milk dried by spraying in a superheated atmosphere. "Dryco" is made from half skimmed milk and dried by spraying on hot rollers. Klim has a food value of 160 calories per ounce and Dryco 130 calories per ounce. Three level tablespoonfuls of Klim or eight level tablespoonfuls of Dryco are equivalent to 1 ounce by weight. One ounce of Klim in 8 ounces of water is equivalent to whole milk and 1 ounce of Dryco in the same amount of water is equivalent to one-half skimmed milk. Dried milk is practically sterile. The vitamin content is not seriously lowered. Dried milks are of especial advantage in traveling or for use in places where good fresh milk is not readily obtainable. Dried milk is also of value as an addition to milk formulas when it is desired to give a concentrated food. The dried milks are readily digestible, and for this reason, and because they are sterile, they have certain advantages over fresh milk. The dried milks are all much more expensive than fresh milk and need rarely be used when good fresh milk is obtainable.

Sweetened Condensed Milk.—This is whole cow's milk evaporated to one-half of its volume and preserved by the addition of about 50 per cent of cane sugar. The most used form is known as "Eagle Brand." It is a syrupy substance which is marketed in sealed cans. The concentration of sugar prevents it from decomposing, even after the can is opened, but condensed milk is not always sterile, as pathogenic organisms have been grown from condensed milk on dilution with sterile water. Condensed milk is not a suitable food for infant feeding. When given in sufficient amount to supply the necessary calories, there is too little milk present to provide sufficient protein, mineral salts and vitamins. Such a one-sided diet often leads to a rapid increase in weight, but the infants so fed are as a class pale, flabby and have very poor resistance to infections. They are often rachitic. Condensed milk has, nevertheless, been widely used in infant feeding and is probably responsible for more deaths among infants than any other one cause. It is supposed to be easily digested, and this is true when it is given in high dilutions, as only a small amount of milk is then present. The popularity of the condensed milk is largely due to the fact that directions for feeding of infants are supplied on the can and in the advertising literature sent to mothers. Furthermore, the feedings are easily prepared. It is a popular form of food with shiftless parents and is often prescribed by ignorant physicians. The only excuse for giving an infant a food so unsuitable is the utter impossibility of obtaining any other form of milk.

Goat's Milk.—Goat's milk is occasionally used for infant feeding. It does not differ greatly in its composition from cow's milk. Goats are not as susceptible to tuberculosis as are cows. In certain countries goats are driven to the customer's door and milked, thus insuring a milk supply fresher than is possible in the case of cow's milk. When good cow's milk is obtainable, the only indication for the use of goat's milk is in the case of infants who are sensitive to the proteins of cow's milk. Such cases are extremely rare.

Proprietary Foods.—Many widely advertised and patented infant foods are on the market. They are of three classes: (1) *Carbohydrates*, consisting of partially dextrinized starch or dextrin-maltose mixtures (Imperial Granum, Dennos Food, Mellin's Food, Mead's Dextri-maltose, etc.). These preparations are all expensive and possess no advantage over ordinary barley flour, dextrin or corn syrup.

(2) *Dried Milk Powders with Added Carbohydrate.*—Examples are Malted Milk (which is dried milk with added malt sugar), Nestle's Food, etc. These preparations are widely used by the laity as the result of advertising propaganda. The physician with even an elementary knowledge of infant nutrition has no need for any of these

proprietary foods, as the desired results can be accomplished as well and better by simple mixtures of milk and sugar.

(3) *Modified Milk with Added Sugar.*—Sweetened condensed milk has already been mentioned and condemned. A modified milk known as S. M. A. (Synthetic Milk Adapted) has been devised by Dr. H. J. Gerstenberger of Cleveland, Ohio. "S. M. A." is prepared by homogenizing a mixture of diluted skimmed milk, lactose and vegetable and cod liver oils. When prepared for feeding the composition is: fat, 3.5 per cent; sugar, 7.2 per cent; protein, 1.2 per cent. The caloric value is 20 calories per ounce.

THE FEEDING OF NORMAL INFANTS DURING THE SECOND YEAR

There should be four feedings in the twenty-four hours given at four hour intervals through the day, leaving an eight hour interval at night. Nothing should be permitted between feedings except water and the allowed quantity of fruit juice. Water should be given liberally, especially in hot weather.

The diet should consist of or be selected from the following:

(1) *Milk*, about 1 quart in each twenty-four hours.

(2) *Cereal* twice daily. Any well cooked cereal allowed, but none of the dry "ready to serve" cereals should be permitted. Before 15 months, the cereal should be strained and served in the form of a thick gruel. Later it may be served as a jelly and still later as well cooked whole grains. Toast, unsweetened zwiebach or dried bread should be allowed, usually not more than three slices in twenty-four hours.

(3) *Vegetables.*—These are usually best given once daily. Spinach, carrots, fresh peas, string beans, dried beans, asparagus tips, cauliflower and potato may be allowed.

(4) *Meat.*—Meat juice and meat broth should be given at least two to three times weekly. The juice and broth are permissible throughout the second year, but meat should not be allowed until after 15 to 18 months, and then it should be finely scraped.

(5) *Eggs.*—During the latter part of the first year the yolk of a hard boiled egg may be added to the diet and given two to three times a week. By 14 months, the child may begin to take the white as well as the yolk, and this may be given soft boiled. Not more than half an egg should be given at a time until the infant is over 18 months of age. Eggs may be alternated with meat.

(6) *Fruits* and *fruit juices* should be given daily. Orange, prune and grape juice may be given. Apple and prune pulp are allowed when thoroughly cooked.

Certain combinations of the foregoing articles of food make an agreeable variation to the diet, such as custards, simple puddings, milk toast, etc.

The daily schedule should be as follows:

6 or 6:30 a. m., milk, warmed, 8 ounces.
9 a. m., fruit juice, from 1 to 3 ounces.
10 a. m., cereal and milk, one piece of toast or zwiebach. Milk, warmed, from 4 to 8 ounces with cereal gruel from 2 to 4 ounces or cereal jelly from 1 to 2 ounces. After 15 months cereals need not be strained, and from 1 to 3 tablespoonfuls may be given.
2 p. m., vegetables or vegetable soup, fruit or milk and beef juice, scraped meat or egg. Milk may be used in making a creamed vegetable soup.
6 p. m., same as 10 a. m.

Table 3.—*Weight-height-age Table for Girls from Birth to School Age*

This table is taken from Woodbury, Robert M.: Tables for Infancy and Early Childhood, Children's Bureau, U. S. Dept. of Labor.

Height (Inches)	Average Weight for Height (Pounds)	1 mo.	3 mos.	6 mos.	9 mos.	12 mos.	18 mos.	24 mos.	30 mos.	36 mos.	48 mos.	60 mos.	72 mos.
20	8	8											
21	9	9	10										
22	10½	10	11										
23	12	11	12	13									
24	13½	12	13	14	14								
25	15	13	14	15	15								
26	16½		15	16	17	17							
27	17½		16	17	18	18							
28	19			19	19	19	19						
29	20			19	20	20	20						
30	21½			21	21	21	21	21					
31	22½				22	22	23	23	23				
32	24					23	24	24	24	25			
33	25						25	25	25	26			
34	26½						26	26	26	27			
35	29						29	29	29	29	29		
36	30							30	30	30	30	31	
37	31½							31	31	31	31	32	
38	32½								33	33	33	33	
39	34								34	34	34	34	34
40	35½									35	36	36	36
41	37½										37	37	37
42	39										39	39	39
43	41										40	41	41
44	42½											42	42
45	45												45
46	47½												47
47	50												50
48	52½												52

Notes:

1. Weight is stated to the nearest pound; height to the nearest inch; age to the nearest month.
2. Up to and including 34 inches the *weights are net*. Above this the following amounts have been added for clothing (shoes and sweaters are not included):

35 to 39 in. 1 pound.
40 to 44 in. 1½ pounds.
45 to 49 in. 1¾ pounds.

TABLE 4.—*Weight-height-age Table for Boys from Birth to School Age*

From Woodbury, Robert M.: Tables for Infancy and Early Childhood, Children's Bureau, U. S. Dept. of Labor.

Height (inches)	Average weight for Height (Pounds)	1 mo.	3 mos.	6 mos.	9 mos.	12 mos.	18 mos.	24 mos.	30 mos.	36 mos.	48 mos.	60 mos.	72 mos.
20	8	8											
21	9½	9	10										
22	10½	10	11										
23	12	11	12	13									
24	13½	12	13	14									
25	15	13	14	15	16								
26	16½		15	17	17	18							
27	18		16	18	18	19							
28	19½			19	19	20	20						
29	20½			20	21	21	21						
30	22			22	22	22	22	22					
31	23				23	23	23	23	24				
32	24½				24	24	24	25	25				
33	26					26	26	26	26	26			
34	27						27	27	27	27			
35	29½						29	29	29	29	29		
36	31							30	31	31	31		
37	32							32	32	32	32	32	
38	33½								33	33	33	34	
39	35								35	35	35	35	
40	36½									36	36	36	36
41	38										38	38	38
42	39½										39	39	39
43	41½										41	41	41
44	43½											43	43
45	45½											45	45
46	48												48
47	50												50
48	52½												52
49	55												55

NOTES:

1. Weight is stated to the nearest pound; height to the nearest inch; age to the nearest birthday.
2. Up to and including 34 inches the *weights are net.* Above this the following amounts have been added for clothing (shoes, coats and sweaters are not included):

35 to 39 in. 1¼ pounds.
40 to 44 in. 1½ pounds.
45 to 49 in. 1¾ pounds.

THE FEEDING OF INFANTS UNDER SPECIAL CONDITIONS

Undernourished Infants.—Infants who are below the normal weight for the age, as the result of improper feeding or disease, need as much total food as normal infants of the same age. The total metabolism of these infants is not very different from that of normal infants and in addition an extra amount of food to provide for delayed growth is necessary. Unfortunately, such infants often have a diminished digestive capacity and are at times unable to take the optimum amount of food. It is therefore important that the food should be one which is easily digestible as well as of high caloric value. For this purpose the mixtures of lactic acid milk and corn syrup are preferable to whole sweet milk dilutions. A satisfactory feeding formula for many malnourished infants consists of undiluted whole lactic acid milk to which has been added approximately 3 ounces of Karo syrup to the quart. This food mixture is easily digested and has a fuel value of 30 calories to the ounce.

Undernourished babies should be fed 5 or 6 times a day, as in this way more total food will be taken than when there are fewer feedings. It is not unusual to see an undernourished infant 6 months of age weighing less than 7 lb. take as much as 5 or 6 ounces of the mixture mentioned 6 times a day or a total of about one quart, having a total fuel value of as much as 1,000 calories. In the case of infants who take very few ounces at a feeding, it is often desirable to raise the food value of the mixture by adding 1 or 2 oz. of dried milk preparations such as "Dryco" to the total day's food. The dried milk has the advantage of increasing the fuel value without appreciably increasing the bulk.

In the case of infants who have become malnourished solely as the result of an insufficient amount of food, a prompt response to proper feeding is to be expected. A considerable number of malnourished infants fail to respond, however, and in these infection is usually present. The most common types of infection are in the middle ear, mastoid, nose and throat or genitourinary tract. Less frequently the chronic infections of syphilis or tuberculosis are present. Any of these infections should be sought for and appropriately treated or the feeding will not be successful.

A certain number of infants have lapsed into such a severe state of malnutrition as to be unable to make use of the food given. Certain of these infants have been shown to have a low blood volume and dependent upon this a poor peripheral circulation. Increasing the blood volume by repeated transfusions often leads to a better utilization of food and consequent satisfactory gain in weight. The intravenous injection of glucose in 10 or 20 per cent solution (20 cc. per Kg. of body weight) is a valuable means of giving an immediately available food supply and of temporarily increasing the blood volume.

Feeding during Acute Illnesses.—During acute febrile illnesses the infant's appetite is decreased. There is, at the same time, a diminished digestive capacity. The general character of the feeding, however, need not be very different from that in health. The milk mixtures used may be of the same type and the infant allowed to take all his appetite dictates. He will usually take less than when well. Solid foods and the various accessory foods such as cereals and vegetables may be omitted temporarily. Water should be offered at frequent intervals and if not well taken should be forced. Food, however, should not be forced during the acute stage of infections, but during prolonged illness food must be forced or given by gavage.

Feeding during Hot Weather.—The infant needs less food during very hot weather and his digestive capacity and appetite are also decreased. Digestive disturbances during hot weather are chiefly due to bacterial contamination of the food. It is especially important that the food should be rendered free from harmful bacteria by pasteurization or boiling and kept free by proper care and refrigeration. Lactic acid milk is an especially suitable food for use during hot weather because it does not furnish a good medium for bacterial growth and because it is readily digestible. As there is a much greater evaporation of water from the body during warm weather, an extra amount of water must be given to infants. Water should be offered freely about midway between feedings if the baby is awake. It is better to supply water in this way than by dilution of the milk formula.

Teething.—No change in the general character of the food is indicated, but it is well to offer the infant hard toast or crackers to chew on. Teething rarely, if ever, causes gastro-intestinal symptoms. If severe diarrhea or vomiting occurs at this time the cause is much more likely to be some form of infection rather than the teething process itself.

Vomiting.—Vomiting during infancy is due to a wide variety of conditions, the most common of which are distention of the stomach by swallowed air, the presence of infections, too frequent feedings, too large quantities at a feeding, gastric irritation due to unsuitable articles of food, pyloric stenosis, acute abdominal conditions such as appendicitis or intestinal obstruction or intracranial conditions.

All young infants swallow a certain amount of air which remains in the stomach for some time. When food is taken into a stomach already containing air, the total volume of the food and air may be sufficient to distend the stomach to such an extent that expulsion of a part of the contents occurs. If a baby is in the recumbent position when vomiting occurs, the food is first forced out. If he is held in an upright position, the air bubble rises to the cardia and is readily expelled. If an infant is held in a semi-upright position during nursing much less air is swallowed than when he is recumbent. Before each feeding a baby should be held up and allowed to belch and after the feeding should be held over the shoulder and patted on the back until swallowed air has escaped. Babies who persistently swallow air and vomit as a result may have to be kept propped up in bed a large part of the time. By simple attention to the detail of elimination of swallowed air, vomiting often ceases in the case of infants, without any change being made in the character of the feeding.

Infants who are fed more frequently than every four hours, are especially likely to vomit and in a fair number of these vomiting ceases when the feeding intervals are lengthened. The forcing of too large amounts of food at a time may be followed by vomiting or "spitting up." Such spitting up is much more frequent in infants who are fed on very dilute milk mixtures than in those given more concentrated feedings. When dilute mixtures are given the infant, he has to take much larger volumes to satisfy his hunger and consequently overdistends his stomach. Some infants seem to have unusually small stomach capacities and these should be given small volumes of concentrated food. The types of concentrated food mixtures used are the same as in the treatment of malnutrition. Infants occasionally develop the habit of rumination or voluntary vomiting. The vomiting effort is often preceded by facial grimaces and contortions of the body. With these infants an effective method of treatment is the feeding of milk mixtures thickened by the addition of 10 or 15 per cent of barley flour, rice flour, or farina. The flour is mixed with a small amount of cold water so as to form a paste and this is stirred into the milk and the whole boiled for twenty minutes. The resulting mixture should be so thick that it adheres to an inverted spoon. Such mixtures can not be fed from a bottle, but can be given from a large nipple with the tip cut off or fed with a spoon.

When pyloric stenosis exists, the vomiting is of a projectile character and waves of gastric peristalsis may be observed. A tumor at the pylorus may, at times, be felt. A certain proportion of cases of pyloric stenosis respond well to dietetic or medical treatment and do not need to be operated upon. In the case of young breast fed infants who are vomiting a great deal as the result of pyloric stenosis, prompt operation is usually indicated. In the less severe cases, the feeding intervals should be lengthened to four hours and atropine given before each nursing up to the physiological effect of flushing. A breast fed baby should not be weaned, but should be operated upon if these measures are not successful.

In the case of artificially fed babies, atropine should be tried. The feeding should be at long intervals and the food thickened as in the treatment of rumination. When vomiting occurs within half an hour after a feeding, an amount of food approximately the same as that vomited should immediately be given. In this way a certain number of infants with pyloric stenosis are able to retain a sufficient amount of food to make normal gains in weight. The food should always be a concentrated one.

In general, the treatment of vomiting consists in long feeding intervals, the giving of a concentrated rather than a dilute food and at times a food thickened so that it cannot be readily vomited.

Colic.—Colic is especially common in babies who are underfed and consequently swallow much air. Gross overfeeding, especially with large amounts of fermentable sugar is a less frequent cause of colic. The prevention of colic consists in the proper regulation of the diet to avoid the errors just mentioned.

Constipation.—Constipation in infants results when there is an insufficient stimulus to peristalsis, when the intestine fails to respond to a normal stimulus or when the food residue is of such a nature as to form firm hard masses which are expelled with difficulty. Since the normal stimulus to peristalsis is food, and especially easily fermentable carbohydrate, an insufficient total amount of food or a relative insufficiency of carbohydrate results in constipation. A food containing a large amount of casein and fat with little carbohydrate, for example cow's milk without added sugar results in the presence of a considerable amount of insoluble calcium and magnesium soaps in the intestinal tract which do not stimulate peristalsis and tend to accumulate in firm putty-like masses. Constipation, therefore, is more frequent in artificially fed infants than in those fed on breast milk with its larger proportion of carbohydrate and smaller proportions of casein. Many artificially fed infants have only one or two firm stools a day and this need not be considered abnormal.

No treatment of constipation is necessary unless there are actual symptoms present. Regulation of the diet rather than the use of laxatives constitutes the proper treatment for constipation. The diet should be adequate in amount and should contain a sufficient proportion of fermentable sugar. The addition of difficultly fermentable carbohydrate such as starch or Karo Syrup, does not usually relieve constipation. A sugar of especial value is liquid malt extract which is highly fermentable. Constipation in the breast fed baby may be conveniently treated by giving one to four teaspoonfuls of liquid malt extract in a small amount of water after a morning nursing. The exact amount to be given must be determined by the response in the individual case. In the case of the artificially fed baby from ½ to 1 oz. of liquid malt extract may be added to the total daily feeding. In the case of infants over a year of age, the addition of prune juice or pulp to the diet is a satisfactory method of treating constipation.

Diarrhea.—Infants are much more likely to develop diarrhea than are older individuals. The digestive tract of the infant is always working rather close to its functional capacity and there is but a small margin of safety, so that any condition which lowers the function of digestion and absorption may lead to the accumulation of food in the intestinal tract which is readily broken down by the organisms present with the formation of irritating products. Furthermore, the bactericidal activity of the gastric juice of the infant is distinctly less than that of the older individual, so that various organisms contaminating the food are more likely to pass into the intestinal tract. Infants also seem to have less immunity to certain intestinal bacterial infections than do adults, for example food contaminated with a small number of dysentery bacilli may bring about serious dysentery in an infant, whereas the same food may cause only slight diarrheal symptoms in an adult. Other bacteria which are apparently harmless to the adult are capable of bringing about diarrhea in the infant. A very common cause of diarrhea in infants is the presence of infections entirely outside of the gastrointestinal tract, for example in the ears, nose, throat, chest or genitourinary tract. Unless these infections are appropriately treated, diarrhea will continue irrespective of any changes in the character of the feeding. It is not generally realized that under-feeding may give rise to chronic diarrhea during infancy. The giving of an adequate diet not infrequently leads to a cessation of the diarrhea.

When an infant is given an adequate diet, properly sterilized, diarrhea is of infrequent occurrence, except in the presence of parenteral infections. Keeping the food free from harmful bacteria is the most effective method of preventing diarrhea during infancy. Food in which there is a disproportionately large amount of fat or easily fermentable sugar should be avoided, as each of these predisposes to diarrhea. Lactic acid milk, because of its acidity is a poor culture medium for most harmful bacteria. The acid milk is also easily digested and therefore not likely to remain unabsorbed in the intestinal tract. This is a good form of food for the prevention of diarrhea, especially during the summer months and is a food to be preferred during an acute attack of diarrhea.

When diarrhea is due to parenteral infection, no change in the character of the feeding is indicated, providing the infant is receiving a lactic acid milk formula. Under such circumstances, the diarrhea will continue as long as the infection is present and will clear with the subsidence of the infection, irrespective of changes in the diet.

When diarrhea is obviously the result of taking some unsuitable article of diet, a short period of starvation may be instituted during which time the infant receives nothing but water by mouth. The customary feeding may then be resumed. In most cases of diarrhea it is neither necessary nor advisable to starve the infant, even temporarily, unless the previous feeding has been an unsuitable one. It is particularly important that no starvation period be instituted in the case of undernourished infants. The feeding should consist of lactic acid milk with Karo syrup in the same proportions ordinarily given to well babies, but the infant should not be forced to take as large a total amount.

In certain rare instances, diarrhea seems to be due to the presence in the intestinal tract of a special group of proteolytic organisms. In these cases, which are rare, it may be necessary to withhold all milk for a number of days and give the infant only carbohydrate in the form of corn syrup or starch water. In any case in which the symptoms of diarrhea are definitely increased by the giving of food, the food should be diminished in amount.

In all cases of diarrhea it is essential that the water supply of the body be maintained. Water must be given frequently in as large amounts as the infant will take. If the weight drops off rapidly and if the infant appears desiccated, water must be given subcutaneously or intraperitoneally in the form of normal saline solution.

In bacillary dysentery, there is fever and usually the presence of blood, mucous and pus in the stools. Dysentery is a self-limited disease and runs its course little influenced by the character of the diet. No food should be given which definitely increases the symptoms, but at the same time the infants should not be starved during the prolonged course of the disease. It is important to realize that the diarrhea continues on any sort of a food or when no food at all is given. A reasonable amount of readily digestible food must be given these infants, even if it has to be gavaged. As fat seems to exert an especially irritating action on the intestinal tract in the presence of dysentery, the feeding should be one low in fat such as boiled skimmed milk or skimmed lactic acid milk, preferably the latter. Easily fermentable sugar should be avoided but 1 or 2 ounces of Karo syrup, or the even less fermentable commercial dextrin may be added to the day's diet. Cereal gruels are fairly well digested, and do not tend to increase the diarrhea. These may, to advantage, be added to the diet in reasonable amounts.

CHAPTER X

DIET AND REPRODUCTION

REPRODUCTION

Fertility is dependent in no small degree on diet. In fact, students of nutrition have come to regard the ability of an animal to reproduce and rear successfully its young as the best criterion of fitness and vigor, and they appraise the nutritive value of a given ration by the number of litters produced by animals on such a diet. Stock raisers appreciate this and give an extra allowance of food to their breeding animals. The practice in the highlands of Scotland of supplementing the food of the sheep just before the period of the annual oestrus is said to increase materially the fertility of the flocks. "The capacity for reproduction is a function of the well-being of the animal, and dietaries which affect the general well-being either adversely or favorably, affect the function of reproduction in like manner."[1]

There are no doubt many unknown factors, but in general it can be said that the character of the animal's food influences fertility in two ways: (*a*) through improvement in general vigor and well-being and (*b*) by means of at least one substance which has a specific influence on reproduction.

Any deficiency, whether mineral, vitamin or protein, is likely to influence fertility in an unfavorable manner; this applies to man as well as to the lower animals. Authentic instances have been reported in which apparent sterility has been corrected by changes in diet. The sexual urge is materially influenced by diet; it has been the experience of those young men who have served as subjects in feeding experiments with reduced rations, particularly when the protein quota was restricted, that there was a distinct lowering of libido. During the war period in Germany Rubner[2] observed that the restricted food supply was responsible not only for a lowering of the libido in men but for amenorrhea and such other menstrual disturbances in women as are known to lower fertility. Mineral deficiency is probably responsible for the fact that rats fed exclusively on cow's milk reproduce little, and that the few young who are born do not long survive.[3] Lack of vitamins will produce sterility. Vitamin A has a profound influence on menstruation and therefore on fertility. The depressing influence of a diet lacking in protein has received frequent comment; Slonaker and Card[4] found that when the rat was restricted to a vegetarian diet there was a marked delay in pubescence with lessening of fertility ranging from 40 to 92 per cent of the normal, and that normal reproductive activity reappeared when a liberal diet containing more protein was allowed. The beneficial influence of a liberal protein intake upon reproduction was discussed with the Protein Problem in Chapter III.

Improvement in the general nutritive state of an apparently well nourished animal or attention to even relatively minor matters of general health would seem to influence fertility. The addition of agar to the synthetic diets of experimental animals has been found to improve intestinal function to such an extent as to increase fertility.[5] Sherman and Campbell[6] found that the addition of milk to an already adequate diet for rats not only improved their general vigor, but also increased their fertility. These authors explain this by the statement: "Evidently there is not only a line to be drawn but a wide zone to be explored between adequate and optimum nutrition."

In short, it has been abundantly demonstrated by animal experiment that deficiency of any kind, great or small, will affect fertility unfavorably, and that anything which improves the general health tends to increase fertility. It has been well stated that reproduction is not the function of the generative organs alone but of the whole organism; the well-being of the entire animal is of determining influence.

Not only is reproduction indirectly influenced by a host of dietary factors, but it is also directly controlled by a recently discovered factor of specific influence. Evans and Bishop,[7] in their studies on reproduction in mice, have discovered that the absence from the diet of a certain specific substance, at first designated substance X but now called vitamin E, will result in a peculiar form of sterility. They were able to observe accurately the complete sexual history of these animals, and they discovered the interesting fact that while the female deprived of this factor but permitted an otherwise adequate diet will conceive in a normal manner, she will not give birth to the expected progeny. They report:

> Necropsies performed late in gestation show various stages in the resorption of the young. A normal proportion of eggs have been fertilized and implanted . . . Some of the implantations have apparently begun to absorb shortly after their establishment. In them no traces of the embryo persists; whereas in other cases macerated embryos or, indeed, large fetuses may be found; rarely a single fetus is found still living . . . Studies of the uterine mucosa just before implantation . . . show that the "implanta-

tion bed" is abnormal, for a quite massive extravasation of erythrocytes has occurred, presumably by diapedesis, infiltrating the connective tissue meshes of the endometrium. When placentas are established, these exhibit a similar type of abnormality, for there are hemorrhages in them and other circulatory faults, chief of which is the occurrence of characteristic greatly distended maternal venous sinusoids.

These authors find that not only the placenta but the fetus also is affected and probably the spermatozoa as well. A group of other workers with mice report: "Male animals exhibit lack of X (vitamine E) in a very different way, and our experience thus far indicates that deprivation of X beyond approximately the 150th day of life probably causes irreparable damage."[8]

The discoverers of this vitamin seem to have demonstrated satisfactorily that it has an identity of its own and is distinct from the other known vitamins. It has been found in liberal amounts in fresh green leaves and dry leaves, especially lettuce; also in whole wheat and oats. It is present in egg yolk and in meats, especially liver and the jaw and cheek musculature of the cow. It is interesting that it is almost totally absent in milk.

Summary.—Many dietary factors influence fertility. Omitting all considerations except those of diet, it can be said in a general way that marriages between people who partake of a liberal well balanced diet, in which are included milk and milk products, a generous amount of protein, an abundance of the green leaves of vegetables and the whole grains, and who thus escape all forms of nutritive failure, are more likely, other things being equal, to be blessed with offspring. When advice is asked concerning the avoidance of sterility it is not out of place for the physician to inquire minutely into the diet of both husband and wife; when dietary faults can be detected, their correction will enhance the likelihood of progeny.

PREGNANCY AND LACTATION

Pregnancy.—The pregnant woman should eat just what any other woman should eat who would preserve full health and vigor. There are no prohibitions which do not apply in equal measure to both. Because of her additional burden, however, it is doubly important that the expectant mother be assured a diet which is in every respect adequate, particularly as regards fuel value, protein content, mineral content and richness in vitamins.

During the first half of pregnancy the woman's metabolic rate is not appreciably altered, and her fuel requirement remains unchanged. After the fourth month, the more rapid development of the fetus calls for a gradually increasing caloric intake. This was demonstrated by studies on a pregnant woman made under ideal conditions by Root and Root[9] as well as by earlier studies on several subjects by Carpenter and Murlin.[10] The data of Root and Root will be found in Table 1 and Chart 1.

These tables show that the basal metabolism in the fifteenth week of pregnancy was 1.5 per cent below the Harris-Benedict standard for a woman of the same height and weight. The metabolic rate gradually increased until a few days before delivery, when it was 23 per cent above that of five months earlier. There was a simultaneous increase in weight of 14 per cent. Had the gain in metabolism merely paralleled the gain in weight, the former would have been only 5 per cent, instead of 23 per cent, greater. Thus, it is evident that the newly formed tissue has a higher specific metabolism per kilogram than that of the woman during sexual rest—37 calories per kilogram for the

TABLE 1.—*Computed Basal Metabolism**

Date, 1922	Oxygen per Minute, Cc.	Pulse	Body Weight (Nude), Kg.	Computed Calories per 24 Hours	Deviation from H. and B.† Standard, Percentage	Calories per Kg. per 24 Hours	Increase in Calories per 24 Hours Over Average of Feb. 9 to March 2 Percentage
Feb. 9	188	90	53.6	1,308	− 1.5	24.4	
Feb. 21	181	76	54.1	1,260	− 5.4	23.3	
Mar. 2	179	76	54.1	1,240	− 7.1	22.9	
Mar. 15	187	76	56.4	1,297	− 4.2	22.4	+ 2.2
April 1	190	80	57.7	1,321	− 3.3	22.9	+ 4.1
April 15	194	87	57.7	1,347	− 1.3	23.3	+ 6.1
April 27	194	84	58.6	1,347	− 1.6	22.9	+ 6.1
May 12	208	99	59.1	1,448	+ 5.2	24.4	+14.1
May 27	204	87	60.0	1,421	+ 2.6	23.6	+12.0
June 13	209	74	60.9	1,454	+ 4.4	23.9	+14.6
June 28	221	82	61.8	1,530	+ 9.5	24.8	+20.6
July 11	218	77	61.8	1,514	+ 8.2	24.6	+19.3
July 19	225	96	61.4	1,561	+12.1	25.3	+23.0
July 26	221	87	60.9	1,530	+10.1	25.2	+20.6
July 31 delivery							
Aug. 6	190	87	52.3	1,321	+ 0.7	25.2	+ 4.1
Aug. 13	187	82	52.3	1,301	− 0.9	24.9	+ 2.5
Aug. 20	168	61	52.3	1,167	−11.5	22.3	− 8.0
Sept. 3	165	58	52.0	1,147	−12.9	22.1	− 9.6
Oct. 1	177	76	53.2	1,227	− 7.5	23.0	− 3.3

* This table is taken from Root, H. F., and Root, H. K.: Basal Metabolism during Pregnancy and Puerperium, Arch. Int. Med. **32**: 411, 1923.

All the metabolism figures reported in this paper were based on the revised methods of calculation resulting from a critical test by Dr. T. M. Carpenter of the Nutrition Laboratory of this portable apparatus (by burning known amounts of alcohol) and represent most accurate measurements of the oxygen consumption.

† "H. and B." is an abbreviation for Harris and Benedict, Carnegie Institution, Washington, Pub. No. 279, 1919, Tables 3 and 4, pp. 260 et seq.

fetus at term, and 23.5 calories per kilogram for the mother at four months. Following delivery there was a gradual fall in the mother's metabolic rate per kilogram to a point 9.6 per cent lower than at the beginning. Carpenter and Murlin state that the mother's metabolism plus that of her infant equals her total metabolism just before delivery.

For a fuller discussion of the metabolism of pregnancy the reader is referred to a recent review by Harding.[11]

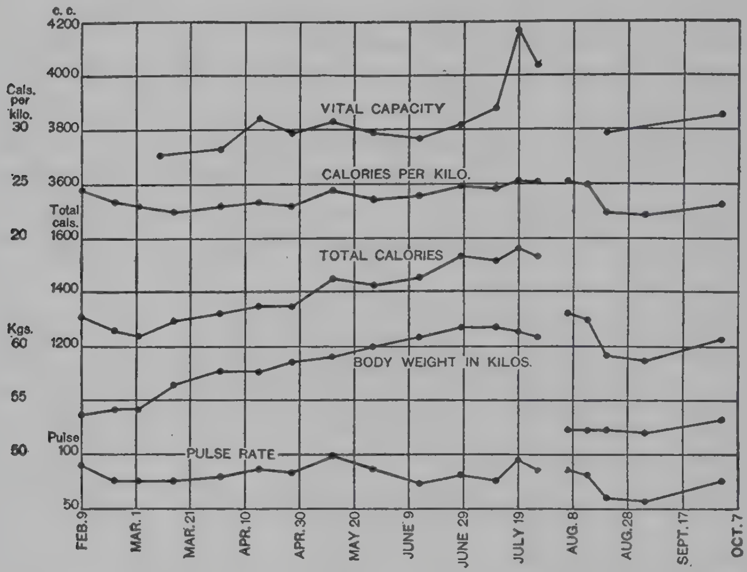

CHART. 1.—Curves for pulse rate per minute, body weight, basal heat production per twenty-four hours and per kilogram per twenty-four hours, and vital capacity from the fifteenth week of pregnancy until the eighth week after delivery (July 31, 1922). (From Root and Root.)

The conclusion is warranted therefore that the expectant mother requires no increase in the amount of food until the fourth month of pregnancy; after this her fuel needs gradually increase until the end of the ninth month, when her caloric intake should be about 20 per cent higher than at the beginning of pregnancy.

Because the pregnant woman is building new tissues, her need for protein increases at a slightly higher ratio than her total fuel requirement. Lack of protein, however, unless extreme, will not affect the development of the fetus; the mother, in case of need, breaks down her own tissues in order to secure the amino-acids necessary for the construction of the fetal tissues, and it is only when starvation is extreme that the fetus suffers. Therefore, for the conservation of her own body tissues as well as for the sake of her infant, the expectant mother should have an adequate protein intake. Meat is of value because of its yield of the requisite amino-acids; the same applies to eggs. Milk is of the highest value, both because of the excellence of its proteins and for other reasons.

Great harm may come to the fetus if the diet of the mother is lacking in mineral elements. This applies in equal measure to the nursing infant. Calcium, phosphorus and iron[12] are the elements for which there is most pressing need. True, the mother up to a certain point will draw on her own stores of ash material in order to supply her infant; but, unfortunately, she thus produces in herself at times dental caries, weakness of the bones and other changes. When her diet, however, is especially poor in mineral elements, the child also must suffer. Milk is very rich in calcium, the element most often lacking in the diet. This is another reason why the pregnant woman and the nursing mother should take milk in liberal amounts. Milk is lacking in iron, but an adequate amount of this element can be obtained from meat, eggs and green vegetables.

Vitamin shortage in the diet of the mother will bring disaster to the off-spring. The body has the power of storing in some small measure vitamin A, but apparently it does not store the other vitamins. Even this store of vitamin A is finally exhausted unless the diet makes good the daily loss. With an insufficient supply of vitamins, the fetus develops poorly and the infant comes into the world defective and a ready victim of disease. It has been shown in experimental animals that the character of the suckling's teeth can often be predetermined at will by varying the vitamin content of the mother's food. The membrane from which the tooth is developed, and which determines its future integrity, is laid down during intra-uterine life; the character of this membrane depends on the nature of the mother's food. If the food is lacking in vitamins, this membrane will be defective, and the tooth will be poorly formed and subject to early decay. It is said that the alarming prevalence of dental malformation and decay in American children is due to faulty nutrition before birth and during infancy and childhood.[13] An adequate supply of vitamins and mineral matter in the food of the mother is the best insurance for good teeth in the off-spring. If flat feet, bow legs, poor musculature and faulty posture are to be avoided, and if the child is to be well developed, robust and active, the food of the mother during both pregnancy and lactation must contain an adequate supply of vitamins and mineral elements.

Attention during the period of pregnancy and lactation should be given to the mother's digestive organs. Fear, anxiety and exhaustion unfavorably influence the digestion, and therefore they should be guarded against. The avoidance of constipation also probably aids in the assimilation of food. It is important that the woman at this time be given simple, easily digested food, and that it be eaten at regular intervals.

To summarize: After the fourth month of pregnancy the diet should gradually be increased in amount until term, when about 20 per cent more calories shall have been added. It should be kept at this increased figure until the end of lactation. This means that the pregnant woman of sedentary habits and of average size should take somewhere between 2,500 to 3,000 calories.

Milk, because of the high biologic value of its proteins and its richness in vitamins and mineral elements, should form a large part of the diet. The woman should take at this time not less than 1 quart of milk each day, preferably more. Milk products, such as cheese, and modified forms of milk, such as custards, cocoa and buttermilk, may in part be substituted.

She should take each day at least one salad and two liberal helpings of green vegetables, such as spinach, lettuce, cabbage, cauliflower, peas and beans. Fruit also is desirable.

To assure the necessary protein intake of 100 Gm. or more, a small piece of meat or fish and perhaps two eggs daily are usually required.

One or two helpings of cereal, preferably from the whole grain, with cream, should be taken. Bran mixed with stewed fruit or pudding of bran and whole wheat is good. A liberal amount of bread and butter should be eaten and perhaps preserves, honey and the simpler desserts. Fats in the form of butter, cream, mayonnaise or bacon should be added in amounts sufficient to bring the fuel value of the diet to the required figure.

It is often advisable to give the nursing mother something between meals. An orange, thin oatmeal gruel with cream, bouillon and the yolk of an egg or milk with graham crackers are suitable.

When the cost of food is not an important factor, menus I to IV inclusive given below may be taken as a criterion of the diet for the pregnant woman who is active and requires about 3,000 calories. When economic considerations are important, menus V and VI may be accepted as guides.

Menus in Pregnancy (Liberal Cost)

Note: These menus do not provide the full amount of milk which is sometimes advisable. In suitable cases one to three glasses daily may profitably be added.

I.

BREAKFAST:

½ orange
5 heaping tbsp. puffed wheat with 2 tsp. sugar and ½ cup whole milk
1 soft boiled egg, 1 small slice of toast, ½ tbsp. butter
1 cup coffee or cereal coffee with 1 tsp. sugar and ¼ cup cream

DINNER:

1 lamb chop
3 heaping tbsp. creamed carrots
Average helping green peas
Lettuce salad with Thousand Island dressing
1 slice whole wheat bread with ½ tbsp. butter
2 heaping tbsp. apple tapioca pudding with 1 tbsp. whipped cream
1 glass skimmed milk

SUPPER:

1 cup cream of spinach soup with 2 crackers
6 panned oysters on toast, 1 tsp. butter
Fruit salad (½ orange, peach, pear) with 1 tbsp. cream dressing
1 whole wheat or graham muffin with 1 tbsp. butter
1 glass milk

BEDTIME: 3 figs or handful of raisins
Average calories—2,585

II.

BREAKFAST:

Small dish of prunes with juice
2 heaping tbsp. oatmeal with cream and sugar
1 medium broiled tomato and 1 crisp slice bacon
2 medium slice toast or 1 large muffin with 1 tbsp. butter
1 cup coffee or tea with cream and sugar

DINNER:

1 medium serving roast beef or fish
1 heaping tbsp. mashed potatoes
2 heaping tbsp. spinach with egg, 1 slice
Medium tomato salad with 1 tbsp. mayonnaise
A. h. prune whip (2 tbsp. prune pulp, 1 egg white, 1 h. tsp. sugar) served with 1 h. tbsp. whipped cream
1 corn muffin with ½ tbsp. butter
1 glass milk.

SUPPER:

1 egg omelet
A. h. stewed tomato
A. h. hominy grits with 1 tsp. butter
A. h. lettuce salad with French dressing
2 medium toast or bread with 1 tbsp. butter
1 small serving fruit ice

BEDTIME: 1 glass milk and 2 figs
Average calories—2,800

III.

Breakfast:
½ grape fruit or 1 peach or pear
3 tbsp. grapenuts with 1 tsp. sugar and ¼ cup cream
1 poached egg on toast
1 cup coffee, tea or cereal coffee with cream and sugar

Dinner:
6 scalloped oysters
Small baked potato with 1 tsp. butter
A. h. creamed cabbage
A. h. beet and egg salad (½ cup beets, 1 hardboiled egg and 1 tbsp. mayonnaise) on lettuce
Fruit cup (½ grapefruit, orange and few grapes)
1 slice bread with ½ tbsp. butter
1 glass milk.

Supper: ⅓ cup creamed dried beef on toast
3 heaping tbsp. buttered carrots
A. h. vegetable salad (1 spoon peas
1 spoon string beans
1 spoon chopped cabbage
A bit of onion
1 tbsp. mayonnaise or French dressing)
1 slice whole wheat bread with ½ tbsp. butter
Liberal size cup or boiled custard
1 glass milk

Bedtime: 1 apple or average helping dried fruit
Average calories—2,800

IV.

Breakfast:
½ glass orange juice
A. h. farina with cream and sugar
2 strips bacon, crisp on 1 slice creamed toast
Beverages

Dinner:
Small serving roast chicken
1 spoon rice with butter
A. h. corn pudding
¾ cup green peas
Medium stuffed (with celery and mayonnaise) tomato salad on lettuce
2 rolls with 1 tbsp. butter
A. h. ice-cream

Supper:
Cream of pea soup with croutons
4 slices dried frizzled beef with 1 medium broiled tomato
A. h. buttered asparagus on toast
A. h. fruit salad
1 glass milk

Bedtime: A. h. figs or raisins.
Average calories—2,775

Menus for Pregnancy (Low Cost)

V.

Breakfast:

A. h. oatmeal with cream and sugar
Dish of stewed apples or prunes
2 slices whole wheat or graham bread
1 tbsp. nut oleomargarine
1 cup coffee with hot milk or cocoa

Dinner:

A. h. beef stew with vegetables (potato, onion, etc.)
A. h. field peas
A. h. greens or cabbage slaw
2 corn muffins or 2 slices bread with 1 tbsp. nut oleomargarine
A. h. tapioca or cornstarch pudding made with canned milk
1 glass buttermilk.

Supper:

A. h. cream of potato soup made with canned milk, 2 soda crackers
A. h. turnips or carrots
Wilted lettuce (Average helping lettuce)
1 tbsp. hot fat
1 tbsp. hot water)
2 slices bread, 1 tbsp. nut oleomargarine
½ cup average helping bread or rice pudding with milk or sauce
1 glass skimmed milk

Bedtime: Handful raisins or 6 or 8 dates.
Average calories—2,800

VI.

Breakfast:

1 small baked apple or apple sauce
A. h. homony grits with 1 tsp. butter
1 scrambled egg
2 slices bread toasted with 1 tbsp. nut butter
1 cup cocoa made with canned milk.

Dinner:

A. h. baked beef ribs with average sized sweet potato
A. h. baked macaroni and tomatoes
A. h. turnip greens
2 corn muffins with 1 tbsp. nut butter
A. h. rice pudding
1 glass buttermilk

Supper:

1 cup baked bean soup with 4 crackers
A. h. buttered onions
A. h. cabbage slaw
2 slices bread and 1 tbsp. nut butter
1 glass milk
1 baked banana

Bedtime: 4 dried prunes and glass of milk
Average calories—2,950

Lactation.—It has been demonstrated on experimental animals that the total yield of milk and its composition can be markedly influenced by changes in the ration. Reduction in protein intake causes an immediate reduction in the quantity of milk produced; the fat content of the milk as the result of protein restriction may be altered in either direction or it may remain unchanged. Reduction in the fat of the ration causes little or no change in the milk, either in amount or composition, until the total fat of the diet falls very low, approximately 1 Gm. per kilogram of body weight; at this point both the quantity of the milk and its fat content will be reduced. Moderate changes in the carbohydrate intake do not seem to effect the amount or the composition of the milk, but when the carbohydrate of the ration falls so low that it represents less than 50 per cent of the total caloric intake, a pronounced falling off in the milk yield follows. A reduction in the mineral ash of the ration is not immediately felt, but there is a gradual reduction in the total milk yield.

Thus it is evident from animal experiment that the protein of the diet is the most important single factor in determining the amount and richness of the milk. Meigs states:[14]

> Changes in the quantity of protein fed have a marked effect on the whole milk yield, with subordinate effects on the composition of the milk. Changes in the amount of fat fed, on the other hand, if they have any effect at all, produce comparatively large changes in the fat content of the milk and only moderate changes in the total milk yield. The situation may be summed up by saying that a serious shortage in any of the food constituents so far studied either throws the milking animal into immediate negative balance as far as that constituent is concerned, or causes her to begin manufacturing the constituent from some other material. In the cases of protein, fat and carbohydrate, however, a serious shortage also has the effect of immediately reducing the amount of milk secreted, whereas a serious shortage of calcium and phosphorus may not affect milk secretion for a considerable time.

The vitamin content of the milk is directly dependent on the richness of the ration in these same vitamins. The animal cannot synthesize vitamins, but must obtain them from the food. Therefore the milk of the cow is richest in vitamins when she feeds on green pastures or silage, and that of the human mother when she eats largely of leafy vegetables, fruits and other vitamin-carrying food. If the food is poor in vitamins, the milk will be poor in respect to these same factors.

In caloric value the food of the nursing mother must be sufficient to meet her own needs and that of her infant plus a certain factor of safety. It is fair to assume that the dietary factors which influence the milk yield of the cow and the goat, which have just been discussed, have a like influence on the human mother. During the nursing period, the infant's daily fuel requirements are about as given in Table 2.

TABLE 2.—*Infant's Daily Fuel Requirements during Nursing Period*

Months	Calories Per Pound
Up to 3	60
3 to 6	50
6 to 9	45
9 to 12	40

Thus the fuel requirement of a mother of average height and weight and of sedentary habits, nursing a 5 month's infant weighing 12 pounds, may be computed as shown in Table 3.

TABLE 3.—*Fuel Requirement of Nursing Mother*

For mother	2,400 calories
For infant of 12 lbs	600 calories
Plus energy lost in converting food into mother's milk	60 calories
	3,060 calories

Roughly, we can say that a nursing mother of sedentary habits should eat as much food as if she were doing moderate work. If in addition to nursing her infant she is actually working, then she should take as much food as if she were engaged in hard labor.

The secretory mechanism whereby the mother converts food protein into milk protein is only about 50 to 60 per cent efficient. Therefore, in addition to the protein ordinarily required for a woman of her size, the diet should provide also about 2 Gm. of food protein for every gram of milk protein which she produces; that is, her food should supply about three-fourths of a gram (0.75 Gm.) of additional protein for every 30 cc. (ounce) of milk she yields. A woman who secretes daily from 800 to 900 Gm. (28 to 30 ounces) of milk should for the production of this milk add to her ordinary diet from 20 to 25 Gm. of protein. Thus, if she is of small size, a daily intake of 100 Gm. of good protein would be sufficient; if she is large, 120 Gm. would be more nearly appropriate. The protein should be of high biologic value, and a material part of it should be in the form of milk, milk products, meat or eggs.

A continuously adequate supply of vitamins to the mother is essential. The leafy vegetables, notably spinach, lettuce, cabbage and "greens" are particularly valuable and should always find a prominent place in the diet. To insure an adequate supply of vitamin C, fresh fruit, particularly oranges, lemons or limes should be taken daily, if only in small amounts. Tomtaoes, fresh or canned.

will serve the same purpose. The necessity for eating an abundant amount of vitamin-carrying foods should be emphasized.

Among the mineral elements, calcium is needed in greatest amount and is most often lacking.[12] It can be secured in abundance from milk and also from green vegetables. An increased supply of phosphorus and iron is also needed. The former can be secured from milk and eggs and the latter from lean meats, eggs, fruits and vegetables. Spinach is of value, not only because of its vitamins, but also for the iron which it supplies.

Milk is the one food which is of greatest value to the nursing mother, not because in itself it stimulates milk production, but because of the high quality of its proteins and its richness in vitamins and calcium. Not less than 1 quart should be taken daily.

Diet for the Nursing Mother (Liberal Cost)

Note: These menus do not provide the full amount of milk which is sometimes advisable. In suitable cases one to three glasses daily may profitably be added.

I.
Breakfast:
½ glass orange juice
1 cup oatmeal, 1 tbsp. sugar, ¼ cup cream
Soft boiled egg, 1 slice toast, 1 tbsp. butter
1 cup cocoa
10: a. m. Glass milk
Dinner:
1 lamb chop
1 heaping tbsp. creamed potatoes
3 h. tbsp. spinach with 1 egg yolk and 1 tsp. butter
Grapefruit salad (½ grapefruit) with 1 tbsp. cream dressing
Small egg custard
2 slices bread or 1 large muffin or roll with 1 tbsp. butter, 1 glass milk
4: p. m. Cup tea with 1 slice toast, 1 tsp. butter, ½ tbsp. jelly or marmalade
Supper:
1 egg omelet with 1 medium broiled tomato
A. h. rice or grits with ½ tbsp. butter
Lettuce salad with Thousand Island dressing
1 Graham muffin with 1 tbsp. butter
Peach or pear sauce (2 halves with spice)
1 glass milk
Average calories—2,900 ±

II.
Breakfast:
1 medium baked apple with 2 tsp. sugar
2 tbsp. grapenuts with 2 tsp. sugar and ½ cup thin cream
1 slice toast, 1 tsp. butter, 1 tbsp. marmalade
1 cup coffee with 2 tsp. sugar, 2 tbsp. cream
or
1 small cup cocoa
10: a. m. 1 glass milk

DINNER:
½ small broiled chicken or steak
1 medium baked potato with 1 tsp. butter
A. h. greens or creamed cabbage
Medium tomato salad with 1 tbsp. mayonnaise
2 slices whole wheat bread or 1 corn muffin with 1 tbsp. butter
Prune whip, 1 glass milk

4: p. m. ½ glass fruit juice

SUPPER:
Toast a la goldenrod (1 hard boiled egg grated over 1 slice creamed toast)
A. h. scalloped tomatoes
Spinach salad (season average helping cold spinach in mold, sit on ice, serve on lettuce with 1 tbsp. mayonnaise)
A. h. date pudding with 1 tbsp. whipped cream
1 slice whole wheat bread or toast with ½ tbsp. butter

BEDTIME: 1 Glass milk
Average calories—2,940

III.

BREAKFAST:
A. h. (four) prunes with juice
A. h. cooked cereal with 2 tsp. sugar and 4 tbsp. cream
1 shirred egg
1 bran muffin with ½ tbsp. butter
1 cup rich cocoa or glass milk

10: a. m 1 cup tea with sugar, 2 tsp. 1 tbsp. milk
1 toasted muffin, 1 tsp. butter

DINNER:
A. h. broiled mackerel with lemon
A. h. baked spaghetti and tomato
Spinach with egg yolk, butter
Carrot and celery salad (1 cup carrots, and celery mixed with 1 tbsp. mayonnaise and bit of onion juice) on lettuce
1 corn muffin, ½ tbsp. butter
Fruit cup (½ orange and grapefruit)
Hot tea with 2 tsp. sugar and 2 tbsp. milk

4: p. m. 1 glass buttermilk

SUPPER:
A. h. creamed chicken on toast
3 tbsp. green peas
A. h. fruit salad with cream dressing, 4 crackers
1 glass milk, 2 heaping tbsp. Spanish cream

BEDTIME: 2 dates or 4 figs
Average calories—2,900+

IV.

BREAKFAST:
½ glass orange juice
4 heaping tbsp. puffed wheat, 2 tsp. sugar, ½ cup rich milk
1 scrambled egg and 2 slices crisp bacon
1 whole wheat muffin, ½ tbsp. butter, 1 tbsp. jelly
1 cup cocoa or coffee with sugar and 4 tbsp. cream

10: a. m. 1 glass milk and 2 crackers

Dinner:

A. h. roast lamb, 1 small baked potato
3 tbsp. green peas creamed
Medium apple and celery salad on lettuce
1 small roll or 1 slice bread with ½ tbsp. butter
Orange custard (1 orange, ⅓ cup boiled custard)
1 glass milk

4: p. m. 1 glass buttermilk

Supper:

A. h. creamed dried beef on toast
Stuffed tomato baked (with bread crumbs or rice; 1 tsp. butter; well seasoned)
A. h. plain lettuce salad with 1 tbsp. mayonnaise, or Thousand Island dressing
1 small slice whole wheat or graham bread, ½ tbsp. butter
Pear sauce (2 halves with juice)
1 glass milk

Bedtime: 2 figs or 4 dates
Average calories—2,800 ±

Diet for Nursing Mother (Low Cost)

V.

Breakfast:

1 cup oatmeal, 1 tbsp. sugar, ½ cup milk
1 dish apple sauce
2 slices whole wheat bread or 1 muffin
½ tbsp. nut oleomargarine, 2 tbsp. syrup
1 cup cocoa made with canned milk (½ milk, ½ water)

10: a. m. 1 glass buttermilk, 1 slice bread, 1 tbsp. peanut butter

Dinner:

A. h. lamb stew with vegetables
A. h. greens
2 corn muffins with 1 tbsp. nut butter
A. h. pickled beets
Large piece gingerbread with small piece cheese
1 glass buttermilk

4: p. m. Bowl vegetable soup, 4 crackers

Supper:

A. h. field peas
A. h. hot whole hominy with ½ tbsp. nut butter
A. h. cabbage slaw
2 slices bread, 1 tbsp. nut butter, 2 tbsp. syrup
1 glass milk, 1 baked banana

Bedtime: Glass malted milk (1 cup milk, 1 heaping tbsp. malted milk powder)
Average calories—3,050

VI.

Breakfast:

1 heaping cup cornflakes, 2 tsp. sugar
½ cup milk with 1 banana
2 muffins with 1 tbsp. nut butter
2 tbsp. syrup
Cup coffee, ½ cup milk, 2 tbsp. sugar

10: a. m. Peanut butter sandwich
Cup hot tea with 2 spoons sugar, 2 tbsp. milk

DINNER:
A. h. roasted soupmeat with baked sweet potato
A. h. field peas
A. h. cabbage slaw
2 corn muffins, 1 tbsp. nut butter
2 heaping tbsp. bread pudding with raisins, lemon sauce
1 glass milk

4: p. m. 1 glass buttermilk

SUPPER:
1 glass buttermilk
2 heaping tbsp. macaroni and cheese
A. h. steamed cabbage
2 slices bread, 1 tbsp. nut butter
2 heaping tbsp. rice custard

BEDTIME: Handful raisins.
Average calories—3,300 ±

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PART II

NUTRITION IN DISEASE

SECTION A

DISEASES IN WHICH DIET IS OF PARAMOUNT IMPORTANCE

CHAPTER XI

DEFICIENCY DISEASES

OPHTHALMIA AND RELATED DISORDERS

Lack of vitamin A retards growth and causes, amid other less clearly defined disorders, a characteristic disease of the eye known as xerophthalmia.[1] This disease at first was thought to come from lack of lipins, but it is now known that the lipins are merely carriers of the vitamin which is the essential factor. This is the type of ophthalmia sometimes seen in poorly nourished people, notably in infants. McCollum quotes Block in his description of fifty cases of xerophthalmia in markedly undernourished children, chiefly infants, and concludes that the disease was due to a deficiency of vitamin A. He quotes also subsequent experiments by the same author in which the addition of whole milk to the diet of a control group prevented the development of ophthalmia.[2]

Xerophthalmia (or keratomalacia) has come to be a well characterized syndrome which occurs in poorly nourished infants or in those who suffer from inanition after infectious disease. It has been observed the world over; in Japan it is known as hikan. The trouble begins in the lacrimal apparatus; first there is loss of secretory function and then comes glandular degeneration. This results in dryness of the conjunctiva with keratinization of its epithelium, which in turn permits the invasion of bacteria with consequent leukocytic infiltration and exudation. Cornification and ulceration of the cornea follow, and the ulcers often perforate. There is nothing distinctive in the bacteriology of this disease: the fundamental characteristic is lacrimal failure and dryness of the eye; after this, bacteria of any kind may gain foothold.[3]

Night blindness (nyctalopia) and the inability to see in a subdued light (hemeralopia) are also related to vitamin A deficiency. Holm[4] demonstrated that the rat when deprived of this vitamin exhibits hemeralopia just as does man, and that in these animals the visual disturbance appears relatively early, to be followed later by xerophthalmia. He and Fridericia[5] made the interesting discovery that this phenomenon is related to injury of the visual purple, since the latter when bleached by exposure to strong light does not regenerate so quickly in animals deprived of vitamin A as it does in those which have been properly nourished. These authors attempt to reconcile the older theory of exposure to strong light as a cause of night blindness[4] with the newer belief that it is a true avitaminosis, by the suggestion that in man a combination of both causes may be operative.

A broader and more far-reaching histopathology of vitamin A deficiency is described by Wolbach and Howe.[6] According to these experimenters, the fundamental feature is a profound change in lining and glandular epithelium—notably of the respiratory tract, the alimentary tract, the genito-urinary tract, the eyes and the para-ocular glands. Proliferation of the underlying cells with keratinization begins in scattered foci and spreads to the entire mucous membrane. The cells lose their specific secretory characters and in every location involved become the same chemically inactive horny cells; the normal epithelium, whether of the covering type or glandular, is replaced by stratified keratinizing cells. The mitotic changes resemble those seen in early carcinoma and suggest perhaps neoplastic proliferation; this leads one to wonder whether it is possible that carcinoma itself bears a relation to avitaminosis. Emaciation with marked loss of fat, localized edema and glandular atrophies are also experienced by animals which have been deprived of this vitamin.

Osborne and Mendel[7] in their experience with rats associate chronic deficiency in this food factor with gastro-intestinal disturbances and also with the production of urinary calculi.

Since cornification of the uterine endometrium and atrophy of the testicles are features of avitaminosis, sterility also may be a sequel. Animal experiment has demonstrated clearly that lack of vitamin A results in lowered fertility.

If we apply to man the information gained from these animal experiments, we must assume that a diet which is lacking in vitamin A can produce the widest range of physical disorders. The child who has received an insufficient amount of this vitamin will be undersized, retarded in development and a ready victim to bacterial invasion. Destruction of the normal bronchial epithelium, as has been described in animals, will conceivably open the way to bacterial invasion and may lead to bronchitis, bronchiectasis and even to tuberculosis. Such profound alteration in the secretory epithelium of the gastro-intestinal tract obviously may lead to digestive disorders; under these conditions, disturbances of secretory, motor and assimilative powers must occur and elicit all types of digestive complaints.

The *treatment* of xerophthalmia and of the manifold other disorders which may arise from a deficiency of vitamin A, resolves itself into the addition to the diet of a sufficient amount of the missing factor. The physical properties of vitamin A and its distribution in nature was discussed in the chapter on vitamins. It has been called the fat-soluble vitamin because of its abundance in certain fats such as butter fat and fish oils; particularly in cod liver oil; it should be borne in mind, however, that lard and the vegetable oils such as olive oil, peanut oil and cotton seed oil are as a rule devoid of this principle.

Butter, cream, milk and cod liver oil are the best remedies. It should be emphasized, however, that the cow cannot synthesize her vitamin A, and that the richness of her milk and butter in this respect depends on the nature of her food—on the amount of grass and silage which she eats. Stall-fed cows with no silage and little pasturage produce a milk which is poor in vitamins, and in the use of which it is possible to permit unwittingly the development of avitaminosis in the child. Skim milk retains a liberal amount of vitamin A.

The yolk of the egg, the organs of animals, particularly the liver, and, above all, the leafy portion of green vegetables are also valuable. The green bud and the leaf of the plant develops its vitamin A while exposed to sunlight; therefore the thin green leaves which have been thus exposed are richest in this factor and should be preferred. Cabbage, spinach and cauliflower are good. Other vegetables which contain yellow pigment, such as carrots, chard, sweet potatoes and squash are also good. It was thought by some investigators that the pigment carried the vitamin; this is now known to be false.

Just how much of these foods the infant or the adult should have for protection it is difficult to say, for we have no way of observing the early onset of deficiency diseases or of clearly recognizing the mild indefinite forms. No doubt there are mild degrees of vitamin A deficiency which do not reach the dignity of disease but which nevertheless prevent robust health. To be on the safe side we can say, and with reason, that the child should have at least a quart of good milk a day and as often as possible some other food rich in vitamins, such as spinach or carrots; the adult, in addition to a reasonable amount of milk and butter, should eat at least 2 helpings daily of salad and two or more portions of the leafy part of some green vegetable.

Cod liver oil is rich in vitamin A and is excellent. It is especially recommended in serious vitamin shortage.

This vitamin is fairly resistant to heat; ordinary cooking does not destroy it to an appreciable degree. It is sensitive to oxidation, however, and prolonged cooking with exposure to oxidation has a destructive influence. Canned vegetables still contain an appreciable amount of their original vitamin A, but in the treatment of disease, the use of fresh vegetables should be insisted on. Properly made milk powder retains this vitamin in active form.

Since sunlight is necessary to the green plant for the normal synthesis of vitamin A, and since this form of energy is of great value in the prevention and treatment of another deficiency disease—rickets—it was thought that it might be of value also in the treatment of xerophthalmia and related disorders. It has been found, however, that while sunlight and other forms of radiant energy may delay somewhat the onset of symptoms, it is of no real value in the prevention or treatment of diseases which arise from a deficiency of vitamin A.[8]

BERIBERI

For centuries beriberi has been endemic in the Orient. Within modern times it has spread to other parts of the world, and today it may be encountered wherever grossly deficient diets prevail. The relationship of this disease to faulty diet was first clearly proved about 1887 by Takaki of the Japanese navy; he was able to show in successive test cruises that the addition of other foods to the sailor's usual ration of polished rice would eliminate the disease. It was erroneously assumed at that time that lack of protein was the cause of the trouble. It seems evident that beriberi is a deficiency disease, but even today, in spite of a vast amount of experimental work and a voluminous literature, the exact nature of this deficiency is not entirely clear.

It was early observed that this disease occurred most frequently among peoples who subsisted solely, or almost so, on polished rice, and that the addition to the diet of the whole grain or of rice polishings would prevent its appearance. Because of the richness of the rice hull in phosphorus, the assumption was that this element is the missing factor, a theory which was later disproved. That rice polishings (and the hulls of other grains as well) contain a substance which will prevent this disease was proved in 1897 by Eijkman[9] in his studies of the polyneuritis of fowls, a disease which apparently is identical with beriberi in man. He found that he could produce polyneuritis gallinarium by a diet of polished rice and could cure it by adding to the ration the "silverskin" covering of the grain. He also observed that other grains when fed to the bird in similar form produced a similar effect, and he concluded that the disease was due to the lack of some substance ordinarily found in the pericarp and embryo of the grain. Grijns, continuing the work of Eijkman, defined more clearly the nature of beriberi; he was the first to call it a "deficiency disease." This worker also called attention to the wide prevalence of the essential factor in most native untreated foods. Finally after the name vitamin had been coined in 1911 by Funk, the designation vitamin B was given to this substance the lack of which was believed to cause beriberi.

The weight of clinical and experimental evidence points to a failure of the diet to supply vitamin B as the cause of this disease, and yet this fault cannot finally be accepted as the sole factor. There are many things which would contradict the assumption that the disease is a pure avitaminosis; it does not develop in man during complete starvation, nor do birds when deprived of all food exhibit the characteristic polyneuritis. A plausible theory is that vitamin B is essential to normal carbohydrate metabolism, and that in its absence the ingestion of a large amount of starch leads to the production of poisons which in turn cause the destructive lesions. In support of this view is the observed fact that the disease most often appears in these who eat large amounts of carbohydrate.

A different opinion is held by McCarrison,[10] who calls attention to the fact that in certain areas in India beriberi is endemic, and that among the inhabitants of those areas even those who eat the whole unpolished grain do not invariably escape the disease. This author's observations lead him to believe that the disease is due to a poison, and that this is permitted to operate by a diet which is lacking in vitamin B or perhaps is otherwise at fault.

Walshe[11] draws a close analogy between the myocardial and nerve degenerations of this disease and the degenerative changes produced by the diphtheritic poison and by alcohol; he accepts this as evidence in favor of a toxic (metabolic) theory of beriberi.

The complexity of the subject is increased by the fact that more than one form of beriberi is recognized, and that there is some doubt after all as to whether wet beriberi, war edema (starvation), dry beriberi and polyneuritis gallinarium, all represent the same disease. It may be that they are merely related, and that the several clinical pictures are produced by different causes singly or in combination.

McCollum,[12] in comparing the edema of beriberi and of starvation, expresses the opinion that protein shortage is the probable cause of starvation dropsy, and that "wet beriberi" may be an expression of two specific dietary faults, protein starvation and lack of vitamin B.

Today we can say only this: beriberi is undoubtedly related to dietary deficiency, and the chief, though not necessarily the sole fault, is a lack of vitamin B.

The *pathologic changes* of this disease can be divided into two classes: (1) degenerative changes with functional impairment of all the organs, particularly in the myocardium and the gastro-intestinal tract; (2) multiple neuritis in the secretory and motor nerves with marked loss of function. The main difference in these two groups is in the extent and permanence of the degenerative changes. In the first the destruction is deep-seated and often irreparable; the heart shows serious destruction of muscle resembling that seen in the toxic myocarditis of diphtheria, while the intestine exhibits atrophy with loss of both secretory and motor control. In the second, structural damage is not so extensive and restoration of function may sometimes be quickly and completely obtained. Graphic illustration of this is seen in the sudden recovery in a few minutes of an almost moribund polyneuritic bird when he is given a few drops of the extract of rice hulls. It is possible that these two types of disturbance are produced by different factors.

The *symptoms* of beriberi vary with the form and the stage of the disease. Distinction is often drawn between the wet form and the dry form. A better classification, as suggested by Walshe,[11] recognizes (*a*) an acute fulminating form, (*b*) a subacute form and (*c*) chronic paralytic beriberi.

Acute beriberi is the rarest form. Symptoms referable to the heart and other organs appear suddenly. Anorexia, abdominal pain and tenderness, vomiting and diarrhea may appear first. Myocardial disease with cardiac palpitation, precordial pain, evidences of circulatory failure and great distress often occur early; they may cause sudden death. These symptoms probably express rapidly progressive degenerative changes particularly of the myocardium.

If death does not quickly ensue, the disease gradually becomes less acute, and a tingling of the feet and hands may appear as the first signs of polyneuritis. Then come disturbances of both sensation and motion —numbness and tingling in the skin, and weakness of the limbs with wrist-drop and foot-drop. Finally, the tendon reflexes disappear. The paralysis may become extensive. As a rule, the muscles supplied by the cranial nerves are spared. During this stage, edema often appears; it may be merely a puffiness beneath the eyes, or it may be extensive and dominate the entire clinical picture. The extensive edema which is experienced by almost all patients in certain epidemics has given rise to the term "wet beriberi."

The subacute group exhibits the milder forms of the disease, such as are commonly encountered in endemic areas. The symptoms are the same as those described for the acute disease, but they are slow and gradual in their appearance and of less severity. Chronic digestive disturbance of indefinite nature, listlessness, lack of energy and increasing weakness with pallor, and finally disturbance of cutaneous sensation and paralysis of the limbs, is the usual order of appearance. Edema may be present; it is seldom entirely absent.

The chronic form presents in marked degree the residual effects of the peripheral polyneuritis. The muscles become wasted, and contractures occur. Lack of coordination and ataxia appear. Sensory disturbance does not progress to such an extreme degree as does motor impairment. The reflexes, preserved for a time, are soon lost; control of the sphincters, however, is preserved. The patient may be greatly emaciated; but, on the other hand he may, because of slight edema, appear well nourished. If he shows extensive edema with general anasarca, he is said to have "wet beriberi."

There is reason for believing that chronic vitamin B deficiency is responsible for many of the obscure, indefinite digestive disorders—disorders which so often destroy the happiness of the patient and baffle the physician. We are accustomed to call these patients neurasthenics and chronic intestinal invalids, whereas many of them are sorely in need of food of the proper vitamin content. In addition, it is possible that many obscure nervous disorders, particularly of the so-called functional type, result from a failure of the diet to provide vitamin B in sufficient amount.

The *distribution* of vitamin B in nature and its resistance to heat and to other influences was discussed in the chapter on vitamins. Suffice it here to say that nature provides this vitamin bounteously, and that is found in almost all native foods. Eggs, yeast and the outer covering of all seeds are particularly valuable sources. The distribution of vitamin B in native foods is so general that it is only through a greatly restricted diet that pronounced vitamin B deficiency is possible.

The *treatment* of the disease consists, first, in correcting the dietary fault and, second, in providing rest for the organs which have suffered degenerative changes. The ordinary food of a well balanced diet contains vitamin in B abundance, particularly if it includes the whole grain of wheat or other cereals. The popular custom today of eating the whole grain rather than highly milled cereals will militate against this deficiency; oatmeal and bran are particularly good. If milk, eggs and green vegetables also form a part of the diet, then an abundance of vitamin B is assured. It is well to insist on a liberal intake of good protein in the form of meat and eggs. Bakers' yeast enjoys a great reputation in the treatment of avitaminosis because of its richness in vitamin B. Spinach, however, is almost as rich and presents distinct advantages over yeast; this is one reason why spinach is so highly valued as a food for infants as well as adults. Potatoes, baked in the skin, cabbage, carrots, turnips and peas are also all good sources of this factor.

SCURVY

Scurvy was the first deficiency disease known to western peoples. In the day of the sailing vessel and of long voyages it was the scourge of the sea; often an entire ship's crew became ill with this disease, and great numbers died. Armies also suffered, and from the crusades down to the recent World War it has been a camp disease.

It was early observed that scurvy occurred in those who did not have access to green vegetables, fruits or other fresh foods. About the middle of the eighteenth century, Lind, a surgeon in the English navy, saw the preventative and curative effects of orange juice and lemon juice and urged their use. Gradually the accuracy of Lind's observations became evident, and lime juice became a regular part of the sailor's ration.

It has appeared probable from the earliest times that scurvy is due to faulty diet, but there has been diverse opinion as to wherein this fault lies. The disease has been attributed at various times to acidity of diet, to infection, to intestinal injury with resulting bacterial invasion, and to the absence from the diet of some essential substance. This last theory was proved to be correct in 1912 by Holst and Frölich[13] in their experiments on guinea-pigs. These workers found that while the animals develop scurvy on a diet of cereals or bread, they will escape the disease if given certain vegetables, such as turnips or carrots—even though the latter diet is insufficient in fuel value for the maintenance of body weight. They concluded that scurvy is due to a failure of the diet to supply some essential chemical substance, and that this substance is destroyed by heat or drying. This body has been given the designation vitamin C. It is discussed more fully in the chapter on vitamins.

The *symptoms* of scurvy in the adult vary according to severity. Listlessness, lack of energy, mental and physical, failure of appetite and irritability come first; then follow loss of weight, weakness and pallor. The joints, particularly the ankles, become tender and swollen. Hemorrhages appear in the skin and give rise to characteristic bluish areas of varying size; these may occur spontaneously or as the result of minor injuries. Ulceration and hemorrhages appear in the mucous membrane of the mouth and on mucous surfaces elsewhere. The gums are swollen and bleed easily; the teeth become loose and may fall out. Headache and other nervous symptoms may be prominent. Hemorrhages everywhere and fragility of the bones are salient anatomic features.

In the infant, Hess[14] has described three types, or rather, grades of severity; the florid, the subacute and the latent. Outspoken infantile scurvy, with bleeding gums, petechial hemorrhages, swollen, tender thighs, pallor and apathetic or perhaps highly anxious expression, is relatively rare; as is also subacute scurvy with its symptoms of less severity. But latent scurvy with its vague, indefinite symptoms, difficult or impossible of recognition, is probably frequent. Failure to grow and develop properly, slight pallor, poor appetite and rapid pulse and respiration should, according to this author, awaken suspicion. The diagnosis becomes clear when rapid improvement follows the administration of orange juice, tomatoes or other antiscorbutic food.

This type of disease often occurs in orphan asylums and similar institutions. Hess and Fish[15] have described such an epidemic among children who were fed on heated milk without the addition of antiscorbutic foods. They say that this condition was promptly cured by the addition of orange juice to the diet, as well as by the substitution of raw for pasteurized milk. Frölich has called attention to the fact that in Norway infantile scurvy is more common among the children of the well-to-do than among those of the poor, and attributes this to the fact that the former receive pasteurized milk and other purified foods, while the diet of the latter contains a larger proportion of rough natural foods. Increasing appreciation today of the value of orange juice, however, militates against this tendency.

The thing which interests us most today is not the cure of well developed scurvy, but rather the prevention of the disease, particularly of the milder forms of latent scurvy, (usually unrecognized) and of the mixed borderline disorders which are related to this disease. Hess has observed that a child or an adult may receive an amount of vitamin C sufficient to prevent the symptoms of atypical scurvy and yet insufficient to meet all nutritive needs, and that nutritional failure results. This is true even among older children. McCollum tells of a boy's preparatory school in which widespread laziness, listlessness and backwardness was the result of a diet lacking in fruits and green vegetables;

the trouble was immediately corrected when foods supplying an abundance of vitamin C were given. In the feeding of large numbers of people, whether children or adults, constant vigilance is necessary in order to supply a sufficient amount of the antiscorbutic factor. This applies particularly to orphanages, asylums, boarding schools and armies in the field.

Lack of vitamin C is a fruitful source of dental disease and malformation.[16] The slogan that a clean tooth never decays is false, for the fate of the tooth is largely determined before its eruption. During uterine life and soon after birth the protective membrane of the tooth is developed, and at this time the integrity of this membrane and the character of the future tooth is determined in part by the vitamin content of the mother's food. It has been found in experimental animals that the character of the suckling's teeth can be predetermined at will by means of changes in the diet. If the mother's food is deficient in vitamin C, the teeth of the young animal will be badly formed and will show early decay; while a well balanced diet, with an adequate supply of vitamins for the mother will insure to the offspring teeth of normal contour and integrity. The importance of this to the human mother is obvious. There is a marked difference in the character of the teeth, both as to form and integrity, in the white and in the colored children of the south, the difference being greatly in favor of the latter, in spite of the colored children's lack of knowledge concerning the toothbrush. The difference lies, I believe, in the fact that the negro mother nurses her child more universally and longer than does the white mother, and that she eats more rough, vitamin-containing foods.

The *treatment* of scurvy resolves itself chiefly into one measure—the inclusion in the patient's diet of a sufficient amount of the missing substance, vitamin C. If the distribution in nature of this vitamin and the factors which destroy it are understood, the arrangement of the diet is simple.

The most important food for the child—milk—is not a highly potent antiscorbutic food; for its content of vitamin C is relatively small. There is enough to protect the infant who subsists solely on milk, but not enough for the older child who takes proportionately a smaller amount. It has been estimated that at least one-half pint of unheated milk daily is necessary to protect the infant against scurvy.[17] For the older child milk must be supplemented by other antiscorbutic foods. This is more imperative if the milk is old or has been pasteurized.

The most important antiscorbutic food is the orange. Equally efficacious is the tomato. One of either (of average size) eaten daily will protect an adult. Even very young infants may with impunity be given orange juice or strained tomato juice in amounts of 30 Gm. or more. It is a good rule, no matter what the diet of the child or infant, to supplement it in this manner.

Next in importance come green vegetables: cabbage, young carrots, spinach, potatoes and rhubarb. Fresh fruits are also of value, apples, strawberries, raspberries and particularly the citrus fruits. Lime juice has enjoyed a great reputation as an antiscorbutic food, but it is now known that some limes, particularly those from the West Indies, are very poor in this respect. Lemon juice is greatly superior to lime juice. Cereal grains and dried peas and lentils which are without antiscorbutic properties will when permitted to germinate for a few days develop vitamin C. This fact may be made use of when fresh fruits and vegetables are not available.

Among meats, the muscle meats contain relatively little of the vitamin, but the organs, particularly the liver, contain it in appreciable amounts. McCollum quotes the experience of Captain Scott's Antarctic expedition when an epidemic of scurvy was stopped by the use of fresh seal meat.

If the foods mentioned above are included in the diet in sufficient amounts, there will be no scurvy, latent or outspoken. If the disease has already developed, the addition to the dietary of orange juice, tomato juice, tomatoes or carrots, cabbage, lettuce, spinach or other fresh vegetables will effect a cure. It is important that vegetables prescribed for this purpose not be cooked too long, and it is especially important during the process of cooking that they be protected as far as possible from contact with air.

It is necessary in arranging the antiscorbutic diet to bear in mind the lack of stability of vitamin C (see Chapter on Vitamins). The solution of the scurvy problem was for a long time retarded by failure to appreciate the ease with which this vitamin is destroyed by physical and chemical agents. Emphasis has repeatedly been laid on the destructive action of heat, but it is only within the last few years that the realization has come that oxidation is an even more potent destructive factor. If foods are protected from air, they will retain their antiscorbutic property for a long time, even though subjected to heat, but the presence of oxygen results in rapid destruction of the contained vitamin C. Pasteurized milk, and even boiled milk which has been protected from oxidation, loses little vitamin C, while that which is stirred or has had its pellicle removed while heated rapidly loses this factor. Even milk powders properly made today by the spray process (Merrell-Soule Co.) are said to retain their antiscorbutic properties.[18]

Acid foods retain vitamin C much better than alkaline foods or those which have been alkalized; the tenacity with which the tomato holds to this vitamin even during the process of canning is an outstanding example. However, orange juice, boiled and rendered slightly alkaline by normal sodium hydroxide, when given immediately by the intravenous route, was found by Hess and Unger to protect animals against scurvy. Emphasis is laid on the immediate administration of the treated orange juice, because it is probable that time permits rapid deterioration of the antiscorbutic factor. This method of administering vitamin C may be used with patients who cannot be given food by mouth.

The effectiveness of an antiscorbutic food often depends on its freshness. The canning of vegetables as a rule destroys a large part of the contained vitamin C. In canned cabbage it was found that 70 per cent of this factor was lost. The tomato, perhaps because of its acidity, is a notable exception. This loss of vitamin C during the process of canning has been shown, however, to be due to oxidation rather than to heat. With adequate precautions it is possible to can both fruits and vegetables with retention of antiscorbutic potency.[19] Orange juice concentrated at a temperature of 40 C. under reduced pressure preserves its effectiveness; tablets made from lemon juice have been found to retain vitamin C for more than a year.

The effort to preserve vegetables by drying and at the same time to conserve the potency of their vitamins is, as far as the antiscorbutic factor is concerned, a failure.

It has been found that apparently insignificant changes in the ionic concentration of the surrounding medium is of destructive influence. The presence of even minute amounts of copper in foods which have been cooked in vessels of this metal destroys vitamin C.[20]

In general it can be said that vitamin C is very sensitive to oxidation, to heat, to changes in reaction and probably to the presence of certain ions. Therefore, fresh foods have the greatest value, and foods which are old, or which have been subjected to heat with oxidation or to other physical changes, in this respect show marked and perhaps complete deterioration. As our knowledge of this subject broadens, it is hoped that we shall be able to preserve vegetable foods by drying and by other means, as is now done with milk, and at the same time to conserve their antiscorbutic potency. For the present, however, in the prevention and treatment of scurvy, fresh foods are essential.

RICKETS

Rickets is a disease of modern times; it is a part of the price we pay for civilization. As Hansemann suggested, it is the result of domestication, of a restricted food supply and an indoor life. It was unknown to the ancients and to our primitive ancestors. The first description of it was by Glisson of England in 1650. It was at first confused with other developmental bony anomalies, but late in the last century our understanding of it became more clearly defined. Its increasing prevalence in recent years has led to extensive experimental studies, and through these in the past seven years our knowledge of its pathogenesis has been greatly clarified. It is a developmental bone disorder which most often attacks children under 2 years of age. It is primarily of the temperate zone, not of tropical or arctic regions. The explanation of this peculiar distribution of rickets is to be found in its cause.

Rickets is clearly a dietary disease; and yet in its prevention factors are concerned which at first glance appear to bear no relation to food. It does not develop if the diet contains a certain factor which McCollum has designated as vitamin D, nor will it appear if the animal enjoys the benefit of an abundance of sunlight. It can be cured by either of these. Evidently both of these factors exert a profound regulatory influence on mineral metabolism.

Much of our knowledge of this disease has come from animal experiment. It can be produced in rats at will by alteration in the diet. While uncertainty still exists as to the influence of the organic portion of the diet, it has been definitely shown by McCollum and his co-workers[21] that the salt content of the rat's ration is a determining factor. They have shown that this disease may develop under either of two apparently opposite dietary conditions: (*a*) a diet low in calcium and relatively highly in phosphorus content or (*b*) low in phosphorus and high in calcium content. The striking feature is that if the two elements are present in proper relative proportions, whether absolutely high or low, rickets does not follow. It should be added, however, that such disturbances in the calcium-phosphorus ratio will not, even under suitable circumstances, invariably produce rickets. Evidently, there are concerned other yet unknown dietary factors.

The dietary abnormalities which produce this disease in the child are even less thoroughly understood. The same factors which produce rickets in the rat should theoretically cause it in the human subject; but in actual experience no such deficiencies are ordinarily found in the diet of the ricketic child; nor do careful studies of diets which have permitted the development of rickets reveal any fault common to all of these children. While the disease is perhaps ten times more frequent in artificially fed infants, it occasionally appears in those who are nursed at the breast. It develops in rare instances even in older children whose food is apparently well balanced and complete. Park[22] writes, "One may state positively that rickets develops on all milk mixtures or on almost all foods or combinations of foods ordinarily given to children. In general, however, the diets of ricketic children, particularly of older children, are open to criticism."

All of this might cause us to question the dietary origin of rickets, but we are forced to admit the existence of nutritive laws which are as yet unknown to us and which may be grossly violated in apparently normal diets. In support of the dietary origin is the fact that the disease can be prevented, produced or cured in the lower animals by certain well understood alterations in the ration. In explanation of the difference in this respect between man and the lower animals, the suggestion has been made that the human organism is highly dependent on the regulatory influence of radiant energy and that in its absence it is exceedingly susceptible to rickets; it is assumed that because of this susceptibility the child will, under suitable circumstances, develop the disease through dietary faults which escape detection or which are not as yet understood.

The relation to rickets of some substance contained in cod liver oil was known to Trousseau. In his extensive studies, Mellanby[23] showed that this oil would both cure and prevent the disease in puppies; and Park and Howland[24] demonstrated by means of radiograms that it would cure children with a tendency to rickets. It was at first thought that the active factor in cod liver oil was identical with or related to vitamin A, but McCollum[25] and his coworkers finally revealed the existence in the oil of an independent factor which will prevent rickets, to which was given the name vitamin D. Lack of this vitamin permits the development of the disease.

Regarding the influence of environment, it has been observed repeatedly that rickets develops most often in children who live in the dark, unhygienic surroundings of city houses. Bad air, infection and lack of exercise were believed to be responsible until the true cause, lack of sunlight, was described by Palm,[26] a medical missionary. Numerous subsequent studies of rickets have attested the preventative and the curative value of radiant energy whether in the form of sunlight or as rays from the mercury quartz lamp. It has been suggested that the manner of action of the two factors, radiant energy and vitamin D, is the same—that the former acts directly and the latter indirectly as the energy of stored sunlight. Either of these two factors will render metabolism more efficient, so that the animal is able, even under the most adverse conditions of mineral deprivation, to maintain the salt equilibrium of the body at its normal level.[22] Howland believed that this is accomplished through the better absorption from the bowel of the necessary mineral elements.

Rickets is encountered most often in children who are under 2 years of age, but older children and adults do not invariably escape. Rate of growth is an important factor in its development, and those infants who grow most rapidly, the premature babies, are most likely to have the disease. This is said to apply also, but to a less extent, to the large, rapidly growing breast-fed baby.

This susceptibility of the young child is explained by the greater dependence of his rapid metabolism on the stimulus received from radiant energy or from its food equivalent, vitamin D, and also by the fact that his diet is not so varied as that of the adult. The physiologic equipment with which a child comes into the world is also of influence; a mother with osteomalacia may give birth to a child so handicapped that he will develop rickets even though he is fed from the breast of a normal wet nurse and lives under surroundings which permit other children to escape.[27]

The geographic distribution of this disease is definitely limited. It occurs most often in middle Europe and in America. It is seldom seen in southern Italy, Spain and Greece, and is rare in northern countries such as Norway and Denmark; Eskimo children, in spite of the fact that they are deprived of sunlight for long periods, do not have rickets. This geographic distribution has been explained by the fact that in hot climates children cannot be kept indoors and necessarily enjoy the benefits of the southern sun with its intense actinic rays, while in far northern regions they are nursed by mothers who consume large amounts of fish oils (containing vitamin D) and are themselves later given a diet rich in the same oils. The great prevalence of rickets in the cities of America and middle Europe is due largely to lack of sunlight. Negro and Italian children living in American cities are particularly prone to the disease, because their skin pigmentation prevents ready access of ultraviolet rays.

The *pathology* of rickets is typical. The deposition of calcium at the junction of the shaft and the cartilage of the bone, where growth normally occurs, does not proceed in a normal manner; tufts of blood vessels carrying preosseous tissue invade and destroy the cartilage, but little or no calcification follows. This destruction proceeds in an irregular manner, so that there exists in this location a mass of weak, osteoid tissue in which is included connective tissue, blood vessels and islands of cartilage. Nature attempts to compensate for this weakness by the further production of osteoid tissue, with consequent enlargement of the bone. The bones are weak and bend easily because of lack of calcium; they show irregular enlargement because of the increased osteoid tissue. The straight sharp line which is seen normally at the juncture of shaft and cartilage becomes widened and is extremely irregular. This is characteristic of rickets and can be recognized in the roentgenogram.

The *symptoms* of outspoken rickets are unmistakable. The manifestations of the milder forms of the disease, however, such as are experienced by high percentage of American children, are more difficult of recognition. It is said that over 50 per cent of the children of our cities are in greater or less degree sufferers from rickets. The baby with this disease is restless and sleeps poorly; constant movement on the pillow rubs hair from the back of his head, a characteristic sign. Children with rickets do not walk early because the ligaments are lax and the muscles and bones are weak; as they grow older, they do not play as other children. Weakness of the abdominal muscles gives them the characteristic pot-bellied appearance. The rachitic rosary, due to enlargement of the junctions of the ribs and the costal cartilages, appears early. There are other deformities of the chest, such as the pigeon breast and the Harrison groove. Bowed legs and knock knees are common manifestations, as are also enlargements of the long bones at the wrists and ankles and bony protuberances on the skull. This weakness of the bones and muscles and the resulting deformity are often accompanied by other evidence of ill health. The child is anemic and is often extremely nervous. Rickets does not kill, but it predisposes the child to infections which may terminate fatally.

Diagnosis, especially in the earlier stages, is made easy by the roentgen ray. The fine clear line which marks the junction of the shaft and cartilage becomes irregular, broader and less sharply defined, and there is a fraying of the end of the bone with perhaps some widening.

The *treatment* of rickets, as in all deficiency diseases, demands the removal of the cause. It is important to secure for the child an adequate diet; this should include always an abundance of milk. He should if possible be kept at the mother's breast, provided the mother herself is healthy and enjoys an adequate diet. Because the growing organism has pressing need for calcium and also because lack of this element in the bone is the salient anatomic manifestation of this disease, every effort should be made to provide abundance of calcium in the food. Sherman and McLeod[28] in their experiments on rats have shown that a liberal supply of food calcium is essential for its proper storage in the body. To insure the infant the requisite intake of this mineral, he should be given always an abundance of milk.

Since an apparently adequate diet for the child will not always prevent rickets, it is important that all children have the benefit of the two factors which under all circumstances will assuredly prevent the disease—sunlight and cod liver oil. Effort should be made to give every child, no matter how robust in appearance, an abundance of sunlight. Infants should be carried into the sunlight each day, properly protected from exposure, and older children should be encouraged to play outdoors as much as possible.

The radiant energy which is of therapeutic value does not come from visible sunlight; it is obtained from the invisible portion of the spectrum with its ultraviolet rays of short wave length. This "antirachitic portion of the solar spectrum" varies greatly with the time of day and with the season. It is most intense from 10 a. m. to 1 p. m., and its influence is vastly more potent in the summer months than in winter. Hess[29] thinks that in northern altitudes the winter sun does not give enough unltraviolet radiation to be of any real therapeutic value. He attributes the greatly superior antirachitic influence of the West Indian and Panamanian sunlight to its richness in this radiation. This author calls attention to the ease with which these rays are obstructed or absorbed by intervening objects, and states that sunlight when filtered through ordinary window glass loses all of its antirachitic properties. For real benefit, the body should be exposed to the direct rays of the sun;—not to diffuse sunlight or to that which has been denatured by window glass. Exposure should occur during the hours of the sun's greatest radiant intensity. Since quartz does not obstruct the ultraviolet rays, it has been suggested that in cold climates nurseries can with advantage be equipped with a few window-panes of quartz glass.[30]

The observations of Hess and Weinstock[31] and of Steenbock and Nelson[32] that foods can be given antirachitic properties artificially by exposure to ultraviolet rays are of practical therapeutic value. Milk powders and even milk can be given greatly increased antirachitic properties by artificial radiation.* More sunlight for the cow, as well as green food with its stored radiant energy, is said to increase the antirachitic powers of her milk. In purchasing milk for children it would not be out of place to inquire whether the cows are stall-fed or have access to green pastures.

Since it is difficult to secure from the winter sunlight of northern climates an appreciable amount of ultraviolet radiation, artificial sources have been called on. The mercury vapor light contains the ultraviolet waves and is of proved antirachitic potency; it is an effective substitute for sunlight. It contains certain rays of much shorter wave length than those of the solar spectrum which reach us, and it is possible that, being unaccustomed to these waves, the body may be peculiarly susceptible to them. Therefore, the patient should perhaps be protected by a filter. Treatments at first should be of two minutes' duration; gradually they may be increased to ten or fifteen minutes, sometimes longer. The distance at first should be 24 inches and gradually reduced to 18 or even 12 inches. The trunk, both front and back, and the lower extremities should be successively exposed. This should be undertaken only by someone familiar with the technic of this treatment.

It is difficult always for the child to secure the sunshine he needs, and relatively few can have access to artificial sources of the ultraviolet ray; hence the almost universal need for codliver oil. Elliott[33] advises one-half teaspoonful of the oil twice daily for babies of 1 month, with an increased dosage in a few weeks to a teaspoonful twice daily. This should be continued until the child is 18 months old. It is as well tolerated in summer as in winter. She stresses the necessity for teaching the mother by demonstration how to give the oil. She says:

> With the baby lying across her lap, the nurse pours out the proper dose in a spoon held in her right hand. With her left hand she opens the baby's mouth by pressing the cheeks together with her thumb and fingers. The oil may then be poured little by little into the baby's mouth. If the mouth is not held open until the oil entirely disappears, the baby will spit out what is left. When this happens, the mother very frequently reports that the baby has vomited the oil. It is frequent for infants to spit out oil not yet swallowed, but in only a few instances have we found that the infant actually vomits it. Attempts to disguise the taste of the oil for very young babies are unnecessary. If by the fifth or sixth month the baby begins to object to the cod liver oil, it may be given with orange juice. Some babies may be taught to take it through a large rubber nipple or from a bottle. In the latter case, more oil than is desired for a single dose must

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* Irradiation of various foods in order to give them increased antirachitic properties is receiving wide publicity. A note of warning, however, has been sounded by Drummond who thinks that other nutritive properties of the food may thereby be damaged. He has found that irradiation of milk will interfere with its taste and will destroy its vitamin A. London Letter. Journal A. M. A. 88, 1014, March 26, 1927.

be put into the bottle to allow for that which will adhere to the glass. The addition of a little molasses or honey to the spoonful of cod liver oil will sometimes disguise the flavor for older children. Most babies and little children can be taught to take the pure oil, if it is looked on with favor by the mother and no unpleasant associations are attached to it. Many children who are given cod liver oil from the earliest months of infancy like it and even "cry for it." Others have to be taught to take it.

Dubin and Funk[34] have repared a concentrate of cod liver oil which exhibits in highly potent form both its antiophthalmic and antirachitic properties. This concentrate, mixed with sugar, has been compressed into small tablets which may carry any desired dose of vitamin D. Fischer[35] reports the effective use in children of these tablets so prepared that one tablet equals one-half teaspoonful of the fresh oil. The tablets are coated to prevent oxidation and should be crushed before use.

Howland[36] wrote: "In codliver oil rickets has more than met its match. On any diet that will support the life of a human being, or an animal, codliver oil will in all probability prevent or cure rickets. Its effect is astounding."

A full discussion of the etiology and pathogenesis of rickets, together with the more important experimental data, will be found in the monographs of Park and Howland, to which reference has already been made.[37]

Infantile tetany is akin to rickets in that it occurs in the low calcium state which is a feature of one form of rickets. Reduced blood calcium is probably related to disturbance of the parathyroid function and to greatly increased sensitiveness of the nervous system; this last leads to the characteristic symptoms of tetany.

OSTEOMALACIA

Osteomalacia is a disease of mineral metabolism which leads to softening of the bones and to skeletal deformities. It is related to rickets in that poor calcification is the salient feature of both; the former, however, represents a retrograde process, while the latter expresses a primary fault in bony development.[38] Osteomalacia is a disease of adults, chiefly of women; it often occurs during pregnancy when the demands on woman's mineral metabolism are greatest, and yet in China it frequently appears among adolescent girls. It is encountered also in the lower animals.

It is a deficiency disease, for it most often occurs in people whose food is meager, particularly if they subsist largely on cereals with little or no meat, fat or dairy products. Low calcium with high phosphorus content is another feature of these diets. "War osteomalacia" was common in the central empires during the World War and was ascribed not merely to starvation but specificially to the absence from the diet of the three classes of food mentioned above. Maxwell and Miles[39] in their studies of this disease in China found that both the calcium and phosphorus of the blood are extremely low. These authors concluded that in addition to faulty diet, lack of sunlight is a potent causative factor. They report that osteomalacia seldom occurs among rich people who have an abundance of good food or among very poor people who work in the fields and enjoy an abundance of good sunlight, but it is frequent among the poorer middle class people who get neither good food nor sufficient sunlight.

In its pathology, osteomalacia represents a failure of calcification to keep pace with the other metabolic processes. In health there is a constant change in the structure of bone as of other tissues, but in this disease there is a breaking down without coincident renewal of the mineral elements. This produces soft, easily deformed bones.

A well balanced diet which supplies an abundance of good protein, fat and calcium is the best preventative. When the diet includes liberal quantities of milk or milk products, as well as green vegetables, meat, butter and eggs, it fulfils this requirement. If the expectant mother will take 2 quarts of good milk daily and will not let false modesty debar her from the benefits of sunlight, she will run small risk of developing osteomalacia. Cod liver oil and sunlight, as recommended for rickets, are both of great value in the treatment of this disease.

PELLAGRA

For a century or more pellagra has been endemic in Italy and Spain and present to a lesser extent in other European countries. It was not until 1907, however, that its prevalence in the United States was recognized and was reported by Searcy.[40] It spread rapidly over the southern states and for about twelve years was almost epidemic. Earlier than this the disease had probably appeared as sporadic cases in asylums and other institutions, but was unrecognized: confederate veterans state that during the Civil War epidemics of pellagra occurred in army camps and prisons. Since 1919 the incidence of the disease in the southern states has been greatly reduced. My own observation is that there are in Alabama today less than one-tenth the number of pellagrins which were seen ten years ago.

The *etiology* of pellagra is still a matter of controversy. In this brief discussion only the outstanding facts can be given. The theory held by the earlier Italian investigators, that the disease is an intoxication from spoiled maize, has been definitely disproven. Today three views are expressed: 1. Pellagra is of infectious nature. 2. It is a deficiency disease. 3. It is due to an infection which attacks people who, because of general malnutrition or of some more specific form of nutritional failure, are especially predisposed.

The Thomas MacFadden Commission,[41] which made an extensive study of this disease in the mill towns of South Carolina, concluded that it was an infectious disease. They were convinced that the pellagra of the six villages studied spread from a center formed by one preexisting case. Overcrowding and poor sanitation were believed to be contributory influences. Vedder[42] reviewed the work of this commission and concluded that faulty diet was probably the responsible factor. He called attention to the close similarity of pellagra to both beriberi and scurvy.

Goldberger,[43] in 1916, published the results of his studies on pellagra in two orphanages and a hospital for the insane in Mississippi, in which he was able to prevent recurrences of the disease by improvement in diet, chiefly by the addition of milk and meat. Inmates in whom pellagra had been manifest the previous year were permanently cured, and in each institution the epidemic was stopped. His subsequent studies in a Mississippi prison camp, where he was apparently able by means of diet to produce the disease in previously healthy volunteers, seemed convincing. This diet, which resembled that most often eaten by pellagrins, consisted largely of cornmeal, white flour, polished rice, sugar, molasses, fat pork, sweet potatoes, turnip greens and coffee; it was low in protein, and its rather high carbohydrate content came almost solely from degerminated cereals.

More recently Goldberger[44] and his associates have endeavored to show that an unknown factor of specific nature is related to pellagra. They state that their studies "are believed to strengthen the interpretation of those previously reported, namely, that in the prevention and presumably causation of pellagra there is concerned a heretofore unrecognized or not fully appreciated dietary essential (factor P-P), and to indicate the probability that this may play the sole essential rôle in relation to the disease." The studies of Goldberger and his associates apparently sustain the belief held by many southern physicians that pellagra is a deficiency disease.

A somewhat similar belief is expressed by McCollum,[45] who emphasizes the fact that man's food deficiency is seldom limited to one particular factor, that in practically all states of malnutrition there are several distinct faults in the diet, and that a combination of these may produce a complex clinical picture. It is possible that pellagra presents a composite picture of this nature, the complexity of which makes an analysis of its cause difficult.

Many students of pellagra endeavor to reconcile the infectious theory with the food deficiency theory, on the assumption that a diet which is excessively high in carbohydrate or is otherwise faulty leads to a form of malnutrition which specifically invites infection, and that the latter actually produces the disease. In support of this compromise theory, it is often argued: first, that Goldberger's results have not been confirmed in actual practice and that the accuracy of his observations can be questioned on the ground that the symptoms produced in the six subjects who were supposed to have contracted pellagra were not sufficient to warrant the diagnosis; and second, that we frequently see pellagrins in whose diet no gross error can be found, and that in many instances in which the food is obviously faulty the patient is in no wise benefited by a full, well-balanced diet, including an abundance of milk, meat and eggs. Partlow[46] of the Alabama Insane Hospital, in which pellagra was once epidemic, is convinced that faulty diet has an influence, but that it is not the sole factor in the production of the disease. Improvement in the diet of the southern farm laborer has not been sufficient to account for the rapid subsidence of the disease. In this respect it has behaved as do the infectious diseases.

The *symptoms* of pellagra fall into three groups: skin, intestinal and nervous. The skin manifestations are most pronounced on the backs of the hands, on the forearms and on the forehead. They often appear on all exposed parts. There is first a simple erythema, which soon becomes a dermatitis of varying degrees of severity. The lesions are so definitely symmetrical as to suggest a nervous origin. They are made much worse by sunlight.

The mouth is sore and is often cracked in the corners; the tongue becomes violently red. There is a reaction of the entire gastrointestinal tract, which is evidenced by gastric anacidity, diarrhea and inflamed anus.

Various nervous symptoms are common. Malaise, irritability, anxiety, vague neuroses, delirium and finally acute mania may appear. Loss of reflexes, ataxia and other evidences of spinal cord degeneration occur as the disease progresses. Pellagra shows a tendency to improve or disappear during the winter months and to recur with increasing severity in the summer.

For *treatment* a diet which contains an abundance of protein in the form of meat, milk and eggs, is universally recommended, but it must be emphasized that such a diet does not always effect a cure. An adult should receive from 100 to 150 Gm. of protein daily. At least one liberal helping of fresh meat and from two to four eggs daily should be eaten. An abundance of good milk, from 1 to 2 quarts daily, is valuable. Fruits and green vegetables in abundance should be insisted on. There is no objection to a reasonable amount of carbohydrate.

Because of the diarrhea, it is occasionally difficult to nourish the patient properly. At such times milk and cereals are best. On the other hand, it is sometimes surprising to see how well pellagra patients, in spite of the diarrhea, will take meat, eggs and other foods. Rest is important; prolonged rest in bed, with an appropriate diet, is of great value.

Because the rays of the sun, especially in the south, aggravate not only the dermatitis but all other symptoms as well, the pellagrin should studiously avoid direct sunlight. Patients with mental symptoms should be carefully watched; they may become violently insane.

Arsenic, as arsphenamine, cacodylate of soda and in other forms has enjoyed a favorable reputation in the treatment of this disease. Experience has failed to convince me of their value. Dilute hydrochloric acid frequently helps the digestion and controls the diarrhea. Bismuth and even opium in the more violent diarrheas, may be given with benefit. Bromides sometimes control satisfactorily the nervous symptoms. Beyond this, I know of no good to be achieved in pellagra by the use of drugs.

SIMPLE GOITER

Iodine is an essential component of thyroxin, which, as has been shown by Kendall,[47] is the active principle of the thyroid gland. If the gland does not receive a sufficient supply of this element, it is unable to manufacture its chief product, and in the effort to meet the physiologic demands made on it, it hypertrophies. This type of simple goiter is characterized by Marine[48] as "a compensatory or work hyperplasia immediately dependent on a relative or absolute deficiency of iodine." It often begins about the age of puberty; other periods of predisposition are fetal life, pregnancy and the menopause. It is more common among females than among males. Adolescent girls in "goiter areas" are particularly likely to develop the disease.

Simple goiter may appear anywhere, but it is endemic in what is known as the goiter regions of the United States and in other parts of the world. In North America, this embraces the Pacific Northwest and the basin of the Great Lakes and the St. Lawrence; elsewhere, it includes all of Switzerland and other mountain regions the world over. The distribution of goiter is related to geologic formation and to the amount of iodine in the water and soil. The disease is frequent wherever the water and vegetables are poor in this element. McClendon and Williams[49] determined the iodine content of the drinking water of various regions and compared this with the prevalence of goiter, from which studies they demonstrated that simple goiter is much more frequent among those peoples whose water supply is deficient in iodine, the frequency of the disease varying inversely with the amount of iodine in the water. Occasionally in restricted areas goiter becomes epidemic, for which no adequate explanation can be given.

Simple goiter can be prevented and often cured by the administration of iodine. A survey of the school girls of Akron, Ohio, made by Marine and Kimball,[50] revealed the great prevalence of this disorder among them; and the subsequent administration of very small doses of iodine demonstrated the prophylactive and curative value of this element. These authors proposed that each pupil of the lower grades be given daily for ten days 0.2 Gm. of sodium iodide, and that those of the upper grades be given double this amount, this procedure to be followed twice each year, in May and December. Marine now regards this amount as excessive; for the normal thyroid can store only about 25 mg. of iodine, and the yearly utilization of this element by the organism probably does not exceed 50 mg. Obviously, minute amounts will suffice, say 10 mg. weekly.

Various other methods of goiter prevention have been suggested. The custom adopted in certain endemic areas of Switzerland of administering from 5 to 10 mg. of iodine weekly as idostarine tablets to each school child is good. This brings about a remarkable reduction in thyroid disease, but the objection has been offered that it does not reach the majority of children early enough, and that it fails to help at a time when aid is most needed—in pregnancy. All pregnant and lactating women living in goiter districts should take weekly 10 mg. of iodine. This element is equally effective in all forms in which it can be administered.

The suggestion has been made repeatedly that a small amount of iodine should be added to the drinking water in those regions where thyroid disease is prevalent. Another suggestion is that laws be enacted requiring that all table salt on the market have a minimal iodine content of 2 Gm. per kilogram; many brands of such iodized salt are now being sold.

A word of warning should be given. Iodine in the treatment of diseases of the thyroid gland can become a two-edged sword. It is of great value in the prevention of simple goiter, and in the minute doses advised it can do no harm. Kimball[51] and other observers[52] have warned against the danger, through the indiscriminate and continued administration of iodine, of inducing hyperthyroidism in old adenomas. This is not an infrequent occurrence. In exophthalmic goiter iodine should be used judiciously and with caution.

For a more complete discussion of this subject, the reader is referred to the two monographs by Marine[53] and to the recent articles by Hathaway,[54] by McClendon and Hathaway,[55] and by McClendon.[56]

GENERAL MALNUTRITION

Man's diet is seldom faulty in respect to one factor alone. When deficient, it usually exhibits several errors, and the resulting clinical picture is correspondingly obscure. To use the words of McCollum, faulty diet does not often produce sudden and graphic consequences; its results are slow, insidious and difficult of recognition. The physician is chiefly interested in nutritional failure not because of its relation to scurvy, beriberi or any other well defined disease, but because it produces numberless vague, poorly defined states of ill health. To prevent nutritional failure, the diet should be considered as a whole, and all essentials, whether vitamin, protein or mineral, should be accorded equal importance. The relation which these bear to one another is also of significance, for that which is optimal under certain conditions may under other circumstances and in other combinations be faulty. An excess of one substance and deficiency of another is a common error. One is reminded here of the ease with which rickets can be produced in young animals by a disturbance in either direction of the calcium phosphorus ratio, and of the production of beriberi by an excess of carbohydrate with lack of vitamin B.

The change from the crude native food of the barbarian to the highly refined concentrated diet of civilized man has led to a great deal of malnutrition and probably to much obscure disease. McCarrison[57] attributes the great amount of digestive disease experienced by civilized people to their refined diets. He tells of the magnificent physique, the robust health, the long preservation of youth and the nervous stability seen among certain tribes of the Himalayas, which he credits to their diet of milk, eggs, whole grains, fruits and the leafy vegetables; he saw no appendicitis, peptic ulcer or asthenic digestive disorders among these people. The vague but insistent digestive complaints of gastro-intestinal invalids may be the expression in a milder tone of the same nutritional faults which in beriberi lead to loss of intestinal neuromuscular control and assimilative powers and to the other distressing symptoms of the disease. It would appear that in a measure at least McCarrison is right.

Poise and stamina, too, are dependent on good nutrition; its failure often leads to instability of the nervous system and emotional imbalance. This is well exemplified by those women who because of capricious appetite or a desire to become fashionably thin have starved themselves to a dangerous degree; the promptness with which these unhappy patients regain their equilibrium when given an abundant, well balanced diet, is good evidence of the part played by proper food in the preservation of nervous stability. The person who has subsisted long on a faulty diet shows also grievous lack of endurance, and easy exhaustion. The reverse of all of this is seen in the superb poise, lack of nervous disease and great endurance exhibited by the more prosperous primitive and pastoral peoples, such as the Himalayan mountaineers described by McCarrison or the pastoral Arabs cited by McCollum. These people enjoy a crude but usually well balanced diet, in which milk and milk products find a prominent place.

Resistance to infection is related to good nutrition.[58] It has been observed in both human experience and animal experiment that a liberal, well balanced diet protects against bacterial invasion, and that recovery from an infectious disease can as a rule be hastened by good food; tuberculosis is a good example. The readiness with which animals in captivity, particularly carnivora, succumb to infection has been falsely attributed to lack of exercise and fresh air; the absence of certain food factors, notably vitamins, is the probable cause. If the young lion, for instance, is occasionally given rabbits, birds and other small animals which can be eaten whole—bones, viscera and all—he will continue robust and strong, whereas on the usual diet of muscle meats, with resulting lack of vitamins, he will often exhibit rickets, infectious disease and early decay.

Likewise in man we can assume that long continued faulty diet will lead to decay and early senility; McCollum has shown that mice reared on a diet within the "twilight zone" of good nutrition exhibit relatively early the signs of senility, and fail to live out their normal span of life. Other animals show the same tendency; man is probably no exception.

Chronic malnutrition leads also to physical inferiority—to small statue, skeletal defects and even intellectual retardation. It has been observed that the children of undernourished families are smaller in statue and are physically and mentally inferior. It is said that such families after a few generations fail to perpetuate themselves.

The inanition of those who in a desire to become stylishly thin, starve themselves to the point of actual injury, deserves especial mention. The diets of these people, as a rule, have two faults: the total fuel value is too low; and because of its supposedly fattening influence, milk is invariably missing. It is fortunate that lettuce and other green vegetables are eaten. Not only does anemia, functional nervous disorders and lack of endurance follow this restricted diet, but sometimes tuberculosis or some other infectious disease supervenes. No one desires obesity with its possibility of diabetes and other grave consequences, but, on the other hand, emaciation is just as bad.

Why are some people undernourished? Inability to secure proper food, ignorance of the laws of nutrition, and capricious appetite—one or all of these causes are usually responsible. In America it is only under rare conditions of extreme poverty that the first cause is effective; the person who knows what to eat can, by dint of effort, usually obtain it. The second reason is the usual one; a failure to appreciate the value of milk, fruits and green vegetables, and phobias toward meat are common. Perverted taste plays a minor rôle. Education is the logical corrective measure.

The *normal diet* was discussed in an earlier chapter. Suffice it to say here that the greatest insurance against nutritional failure for child or adult is an abundance of milk and green vegetables. Sherman[58] in reporting certain experiments says:[57] "One quart of milk per day in the human dietary greatly increases the vigor of the young adult." For use in this connection McCollum has coined the term "protective foods"—protective because they supply the substances most often lacking in the diet and therefore protect against nutritional failure. First and foremost among them is milk; next in importance are the leafy vegetables and certain fruits, particularly the lemon, orange and raspberry; a little lower in the scale come eggs and the glandular organs, such as liver, kidney and pancreas. If civilized man will supplement his diet with a sufficient quantity of these protective foods, he will escape many forms of nutritional disaster.

No discussion of malnutrition would be complete without mention of the important influence of sunlight. Experience with rickets, both experimental and clinical, has shown that radiant energy has a powerful regulatory influence on metabolism. To insure normal metabolic activity and the proper nutritive state, the person should, therefore, have the benefit of a liberal amount of sunlight. This is best obtained in the middle of the day when the actinic rays are most intense.

A graphic account of the ill effects of undernutrition as observed in Germany during the World War was recently given in an address by Friedrich v. Müller.[59]

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CHAPTER XII

DIABETES MELLITUS

METABOLISM IN DIABETES

Diabetes mellitus is a disease of metabolism, the salient feature of which is a lessening or complete loss to the cell of the capacity for the utilization of sugar. The pancreatic hormone, insulin, which is essential for the oxidation of sugar, is lacking. It is probable, too, that through disturbance of the vegetative nervous system there is an interference with the rôle which the liver normally plays in carbohydrate metabolism. Deprived of its ability to oxidize sugar, the cell loses its most important source of energy, and this unsatisfied need for fuel leads to the destruction of protein and fat with the liberation of still more carbohydrate and finally to the accumulation of certain poisonous fatty acids. The unutilized sugar accumulates in the blood and is excreted in the urine.

Insulin is produced by the islands of Langerhans of the pancreas. Why it is lacking in this disease is difficult to explain; repeated mild attacks of pancreatitis are probably responsible in some instances, while in others there are degenerative changes in the pancreas of unknown origin. Heredity in the form of familial and racial predisposition plays an important rôle.

The relation of obesity to diabetes should be emphasized. People who habitually overeat are especially prone to the disease and this tendency increases enormously with age if at the same time the person is grossly overweight. Elderly persons who remain thin are not so predisposed. This penalty of obesity, as Joslin calls it, may explain perhaps the inherited tendencies noted above, for dietary faults and their penalties are common to families and races.

Nervous influences unquestionably play a rôle. Diabetes is distinctly more frequent in mental workers than in manual laborers, and it is probable that the increasing incidence of this disease in America is due to our gradually changing manner of living. It is always more frequent among people who have an abundance of good food and ample leisure than among those whose food is scanty and who must work hard.

Patients with diabetes can be divided roughly into two groups: those with mild cases and those with severe cases. The severe types occur most often in children and in young persons, and the mild forms in those who are in the later decades of life. Geyelin[1] feels that there is a fundamental difference between these two groups, and he applies to them the Presbyterian doctrine of predestination. He states that the essentially mild case is likely to remain mild, and even though neglect of treatment, emotional disturbance or infection may for a time apparently make it a severe case, it will if given a chance eventually pursue a benign course. Proper treatment will as a rule result in the return of the condition in this type of case to its originally mild status. On the other hand, the essentially severe case, even though at times it may appear mild, is likely to progress in severity, to be difficult of metabolic control and eventually to end disastrously. While this division into two types cannot be absolute, and while exceptions and borderline cases occasionally occur, it has the support of clinical experience.

The Total Metabolism of Diabetes.—Opinion in the past regarding the total metabolism of this disease has been conflicting. Some investigators have found it elevated; others have found it lowered. Joslin,[2] in his metabolic studies on a large number of diabetic patients as published in a recent monograph, has provided an explanation of these discrepancies. He has shown that during those years when the overfeeding of diabetic patients was the rule, the average basal metabolism was +12 per cent, whereas during the subsequent period (after June, 1914) when undernutrition was the rule, the average basal metabolism was −11 per cent. The conclusion seems justified that in persons with mild and moderately severe cases of diabetes the basal metabolism does not deviate from the normal, while in those with severer cases accompanied by marked undernutrition the basal metabolism is subnormal, as much perhaps as from 30 to 40 per cent. In some patients, because of extraneous influences such as diet, exercise, infection, etc., wide fluctuations of basal metabolism may be encountered. Joslin writes: "One might say that the metabolism of the disease diabetes, even of severe diabetes, varies but little from normal, but that the metabolism of the diabetic patient, particularly the severe diabetic patient, varies greatly from normal, not from intrinsic causes as with the thyroid patient, but from extrinsic causes of which the diet is the chief cause." To maintain a low metabolic rate by means of moderate undernutrition is one of the objects of treatment, for at this lower level of metabolism there is a distinct improvement in the utilization of glucose.

Joslin inclines to the view that acidosis increases metabolism. Wilder, Boothby, and Beeler,[3] however, attribute such increased metabolism as occurs during acidosis not to the acidosis itself but to an ultimate cause which produces both. Nevertheless, it is true that severe acidosis is accompanied by a markedly accelerated metabolic rate.

The Respiratory Quotient.—This quotient gives an insight into the nature of the foods metabolized and their respective amounts. Persons with mild diabetes who are able to metabolize a liberal amount of carbohydrate as a rule give a relatively high respiratory quotient, while those whose tolerance is low give a low quotient. The average man on a mixed diet will have a respiratory quotient of, say, about 0.83, but the diabetic patient, even one with the milder type of disease, as a rule, has a lower figure. Joslin reports that the average respiratory quotient of his patients during the years of overfeeding was 0.76, and during the subsequent period of undernutrition was 0.78. Unusually high and unusually low quotients are occasionally encountered and are sometimes difficult of explanation.

Carbohydrate Metabolism in Diabetes.—Carbohydrate utilization is limited because of lack of insulin, and the unutilized sugar accumulates in the blood. In health the blood contains approximately from 0.08 to 0.1 per cent of sugar; wider variations are frequently encountered. When during fasting the blood sugar exceeds 0.14 per cent, diabetes should be suspected; higher percentages point almost conclusively to this disease, but as a rule more than one test is desirable. It is not infrequent in diabetes to see a fasting blood sugar of 0.2 or even 0.4 per cent. Increased blood sugar is practically always accompanied by sugar in the urine. The glucose threshold varies with different patients, and the exact point at which hyperglycemia leads to glycosuria is not always the same. As a rule, when the former is 0.17 per cent the latter appears. Blood sugar estimations are of value not only in recognizing diabetes, but also in formulating the prognosis. Since, however, these tests offer certain technical difficulties for the general practitioner and cannot always be performed, we must accustom ourselves to depend largely on the information obtained from frequent examinations of the urine.

Few patients are completely diabetic; the great majority of them can burn at least some carbohydrate. Also, the diabetic patient has not entirely lost the ability to store carbohydrate and to release it later for metabolism. This faculty for storing carbohydrate, which no doubt varies with the severity of the disease, must be taken into consideration not only in metabolic experiments, but also in clinical work. Joslin tells of von Noorden's patient, who stored 520 Gm. of carbohydrate while undergoing an oatmeal cure. Diabetic patients are often able to store comparatively large amounts of levulose; there is ground for the belief that at least a part of this is converted into fat and is stored in this form. It is probable, however, that a not inconsiderable part of the carbohydrate retained by the diabetic person is stored in the liver and muscles in the form of glycogen.

In all reckonings of carbohydrate metabolism, clinical as well as experimental, it is the ultimate carbohydrate, not merely that which has been eaten as such, which must be considered. Fifty-eight per cent of the protein metabolized and about 10 per cent of the fat, yield glucose, and this glucose as far as metabolism is concerned, differs in no wise from that taken as such by mouth. This explains the often observed excretion by a person with severe diabetes of more carbohydrate than he has actually received.

Protein Metabolism.—This demands attention in diabetes for four reasons: (*a*) Certain amino-acids of the protein molecule are converted during metabolism into glucose, giving at least 50 per cent yield of the latter; (*b*) other of the amino-acids are converted into poisonous fatty acids which increase the hazard of ketosis; (*c*) through its specific dynamic action protein greatly stimulates metabolism, an influence which in diabetes is to be studiously avoided, and (*d*) in other ways it possibly interferes with the mechanism of glucose utilization and thus lowers the diabetic patient's ability to utilize carbohydrate.[3]

The Dextrose-nitrogen Ratio.—The "D:N ratio" as it is called, gives the quantitative relationship of dextrose to nitrogen in the urine, and therefore the proportion of dextrose excreted to protein destroyed. Each gram of urinary nitrogen represents the destruction in metabolism of 6.25 Gm. of protein, and since 58 per cent of protein is converted into glucose, the metabolism of this amount of protein results in 3.65 Gm. of glucose (58 per cent of 6.25 equals 3.65). Therefore, each gram of urinary nitrogen represents the production in intermediary metabolism of 3.65 Gm. of glucose; if the patient is unable to burn any glucose, all of this will appear in the urine. Conversely, should the patient who is fasting or is subsisting exclusively on protein and fat show in his urine 3.65 Gm. of glucose for each gram of nitrogen excreted, a D:N ratio of 3.65, then it is evident that he is excreting all of his carbohydrate, and that he is completely diabetic. This ratio is frequently seen in experimental animals, but it is a rarity in persons who have diabetes.

Fat Metabolism.—This is of great interest in diabetes because when it is disturbed through inadequate oxidation of the fatty acids, coma may appear. For the proper utilization of fat the simultaneous oxidation of a definite amount of glucose is essential; if the body is unable to burn the requisite amount of glucose, a part of the fat is incompletely oxidized and fatty acids accumulate to act as poisons. Rosenfeld said that the fats burn in the fire of carbohydrate, and that without it the fire smokes, and Woodyatt has appropriately likened the fatty acids thus formed to the smoke of an automobile which has a poorly adjusted carbureter. Fat, however, is not the sole source of these acid, or ketone bodies, for protein through certain of its amino-acids, particularly leucine, phenylalanine and tyrosine, also furnishes them. The ketone yield of the several foodstuffs is: for fat, 90 per cent; for protein, 44 per cent; for carbohydrate, none. Only those fatty acids which have an even number of carbon atoms yield ketone bodies, but the practical importance of this is lessened by the fact that the edible fats contain only such acids as have an even number of carbon atoms (Intarvin!).

The "Ketogenic-antiketogenic Ratio."—This ratio expresses the amount of fat which can be safely oxidized through the aid of a given amount of glucose. On the basis of respiratory quotient and test tube experiment, the estimate has been made that one molecule of glucose will permit the oxidation of one molecule of higher fatty acid. Shaffer[4] reduced this estimate to grams as follows: Since the average molecular weight of the commoner fatty acids is 270 and that of glucose is 180, then 270 Gm. of fatty acid require for oxidation 180 Gm. of glucose, or 1.5 Gm. of fatty acid to 1 Gm. of glucose. Woodyatt[6] has elaborated on this ratio and made it available for every-day metabolic reckonings in the following formulas:

If C = carbohydrate, P = protein, F = fat (neutral), G = total quantity of glucose from all sources introduced into the body, and F. A. = total quantity of higher fatty acids including those derived from protein, then,

$$(1)\ G = C + 0.58\ P + 0.1\ F$$
$$(2)\ F.\ A. = 0.46\ P + 0.9\ F$$

Taking the ratio stated above, FA: G :: 1.5:1, then

$$(3)\ \frac{F.A.}{G} = 1.5$$

From equation 1, 2 and 3 we reach, by elimination,

$F = 2.C + 0.54\ P$, or for clinical purposes, (4) $F = 2\ C + \frac{P}{2}$, which means that the fat may safely equal twice the carbohydrate plus one-half the protein. If the amount of fat oxidized does not exceed twice the carbohydrate plus one-half the protein, expressed in grams, then the ketogenic-antiketogenic ratio is preserved and all fatty acids will be safely oxidized. For example, if the patient metabolizes 80 Gm. of carbohydrate and 50 Gm. of protein, then the amount of fat he can utilize safely is $2(80) + \frac{50}{2} = 185$ Gm.

Much higher ratios have been formulated, and these, under certain circumstances, are unquestionably safe, but it is becoming increasingly evident that no ketogenic-antiketogenic ratio can be regarded as a fixed one. Wilder[3] and his associates suggest that the amount of fatty acid which can be burned with a fixed amount of glucose is not the same at all metabolic levels but may be increased by measures which lower the metabolic rate. Shaffer,[5] in a later communication, expresses a somewhat similar conclusion: "Some subjects undoubtedly show small but definitely abnormal amounts of acetone when the mixture of metabolites, judged by the respiratory quotients, or by calculations, corresponds to a $\frac{\text{Ketogenic}}{\text{Total glucose}}$ ratio of about 1:1; while other subjects may have a ratio of almost 2:1 before large amounts of keto- and hydroxybutyric acid appear in the urine." The higher ratios for fat were formulated before the discovery of insulin, at a time when it was possible to permit patients with severe cases of diabetes only very small quantities of carbohydrate. Therefore in order to provide requisite energy it was necessary that such a diet furnish the highest quantity of fat consistent with safety. Now, thanks to insulin, the carbohydrate of the diet can be increased to any reasonable amount, and we are not impelled to reach the highest possible ratio of fat.

The keto-antiketogenic ratio means nothing unless the diet provides protein and total calories in amounts sufficient to approximate the patient's metabolic requirements.

Woodyatt[6] was the first to emphasize this when he called attention to the fallacy of thinking of a patient's food supply solely in terms of diet to the neglect of endogenous factors. The endogenous food supply, that derived from the patient's own tissues, throws just as heavy a burden on metabolism as does the same amount of protein or fat when taken by mouth; the chemical processes are identical. The same ketone bodies come from faulty metabolism of body fat as from exogenous fat. The patient who is starving or who receives a diet inadequate in energy or protein must necessarily draw on his own body fat and protein. In all reckonings we must think of food in terms of metabolism rather than of diet.

Three facts concerning the metabolism of the diabetic patient warrant emphasis: 1. The ketogenic-antiketogenic ratio is probably the most important single principle in the treatment of diabetes and must always be kept in mind. 2. The endogenous food supply is just as important as the exogenous supply of the diet. If the amount of food supplied by the diet is below the patient's caloric needs, he must necessarily draw on his own body fat and protein, and this possibility must be considered in all reckonings. 3. It is the food metabolized, not merely that eaten, which counts; carbohydrate which is taken by mouth and passed out in the urine cannot be counted in metabolic reckonings; this must be subtracted from the known food supply.

THE PREVENTION OF DIABETES

For the person whose habitus or whose inheritance renders him likely to contract diabetes, much may be accomplished by dietary precaution. The same can be said of the person in whom the occasional appearance of transient glycosuria indicates perhaps incipient diabetes. Since, as has been shown by Paullin[7] and others, obesity is a frequent forerunner of diabetes, the middle-aged person should strive to keep his weight within normal bounds. This can best be accomplished through the medium of sufficient exercise and an abstemious diet. In such a diet all reasonable foods may be permitted, but the total quantity should be strictly limited. It is the quantity, as a rule, rather than the kind of food which counts; overindulgence of every kind should be avoided. The prevention of obesity often means the prevention of diabetes.

A diabetic inheritance, or a tendency toward transient glycosuria, demands certain additional dietary precautions. Not only must the person so handicapped keep his weight at or below the normal standard, but he must be extremely temperate in the use of sweets. It is doubtful whether ordinary overindulgence in sweets by a normal person will bring on diabetes, but for the person with a tendency in this direction such overindulgence may be a determining factor. He should take sweets only in strictest moderation, preferably in the form of the simpler desserts and always after meals—never as candy and similar sweets, and never between meals. The avoidance of sauces and highly seasoned foods is also advisable. The patient who has so-called alimentary glycosuria or the glycosuria of pregnancy should be watched over a long period and should be looked on always as a potential diabetic.

RECOGNITION OF THE DISEASE

Before instituting treatment assurance must be had that the patient actually has diabetes mellitus; for there are many forms of glycosuria which may be misleading. So-called renal glycosuria and the glycosuria of pregnancy give most trouble in this regard; it should be borne in mind that the latter if neglected may progress to true diabetes. The glucose tolerance test gives a good idea of the ability of the patient to burn glucose, but caution should be exercised in its use; a person with severe diabetes may be made much worse by subjection to this test. The adult patient while fasting is given 100 Gm. of glucose in lemonade; blood sugar estimations are made before and three hours after taking the glucose. In every person there is a rise in blood sugar, but the promptness with which it falls to its original level is the best criterion of his ability to burn glucose. John[8] regards a curve which at the end of three hours has fallen to its former level as evidence of normal glucose utilization and a hyperglycemia which persists longer than three hours as suggestive of diabetes.

Woodyatt[9] regards the power to burn glucose under a rising supply as a good criterion. He advises:

> Doubtful cases may be placed on a series of graded iso caloric diets having glucose values of 100, 200, 300 gm. respectively and so on upward if necessary. The patient should remain on each diet for at least three days during which the 24-hour outputs of sugar are accurately determined by a method such as that of Benedict and Osterberg or Folin and Berglund. The average excretion for the successive periods may then be plotted. The line or curve so obtained usually gives valuable information. One or more blood-sugar percentage determinations before breakfast when the patient is on each diet may be of assistance if they run persistently low. The true typical diabetic case shows an upward break or bend in the excretion curve beginning at a definite point. Failing to demonstrate a sharp break or progressive acceleration of the glycosuria with a rising glucose supply, one may well hesitate to make too severe a prognosis or impose too rigid restriction on the patient.

As a rule, however, the vast majority of patients who show a persistent glycosuria or a persistently elevated blood sugar have diabetes, and those who show occasional transient glycosuria should be tentatively regarded as potential diabetic patients.

THE FUNDAMENTALS OF DIETARY MANAGEMENT

The discovery of insulin has made it infinitely easier to provide suitable food for the diabetic, and has brought comfort and longevity to large numbers of patients, but it has not obviated the necessity for precision in diet. The diabetic patient who trusts solely to insulin and eats everything he pleases will surely come to grief. There is demanded today the same careful thought and the same precision in detail as during the past. While the diet should be planned always to meet the needs of the individual patient, there are certain general principles which should govern its selection.

Undernutrition.—The metabolism must be kept low, and to this end the patient should be permitted only such an amount of food as is necessary to meet his minimal metabolic requirements and to prevent his drawing on his body tissues. This curtailment of food will reduce the metabolic rate, which reduction will in turn make it possible to maintain nutritive equilibrium on a materially lessened intake. Wilder[3] and his associates in their studies of about a year on a patient with a severe case of diabetes found that the ability to utilize glucose varied inversely with the metabolic rate. "When the rates were lowest the glucose utilization was best and acidosis was either controlled or decreasing. When the basal metabolic rate rose . . . sugar tolerance diminished and acidosis increased." Evidently the benefits achieved from undernutrition are not due to mere loss of body mass but rather to the improvement in glucose utilization which comes with the adjustment of metabolism to a lower level.

At the same time it is important that enough food be given to at least approximate energy requirement; otherwise the patient will draw on his own body fat and protein—a circumstance, which, if unrecognized, may entail nutritive failure or even disaster. Since the total caloric requirement of the diabetic patient does not differ materially from that of the healthy person, the figures given in the chapter on basal metabolism can be utilized. This necessity for undernutrition, however, requires that slightly lower values, say 10 to 20 per cent below normal, be adopted. The metabolic rate of the individual patient varies within rather wide limits and is seldom the same at different periods of the day, but for practical purposes, we can assume for the twenty-four hours a basal metabolism of 25 calories per kilogram of body weight. A slightly lower figure, say 20 calories, will sometimes apply to thin, moderately emaciated patients. The average diabetic patient, however, should have a diet based on the higher figure. This estimate expresses the basal metabolism of the normal person who is completely at rest. Since the metabolism of the diabetic person, however, is reduced about 10 to 15 per cent through undernutrition, his rate is actually lower than in health, and this caloric allowance (25 calories per kilogram) will probably be found sufficient to meet not only his basal requirements but also the increment which comes from getting out of bed and sitting around the room.

On the other hand, many clinicians feel that to this basal figure there must be added an amount of food sufficient to take care of even the effort of sitting around the ward; an additional 500 calories is regarded as sufficient. If the diabetic patient is engaged in a greater activity or in actual work, a material addition to the basal allowance must be permitted; the caloric intake under such circumstances should be based on the estimated energy requirements given in Chapter III (page 66) but to insure undernutrition, it should fall short of these figures about 10 to 20 per cent.

Carbohydrate Restriction.—To rest the pancreas the patient must be given only such an amount of carbohydrate as he can metabolize without the appearance of sugar in the urine. This principle of resting the pancreas has long been the basis of diabetic therapy. If the islands of Langerhans are overstimulated by the insistent demands of an excess of sugar in the blood, exhaustion and degeneration follow; if, on the other hand, through the limitation of carbohydrate metabolism they are permitted to rest, then restoration of function, at least to a certain degree, follows. If glycosuria is permitted to persist, the disease as a rule grows worse, whereas if the urine is kept sugar-free a gradual increase in tolerance ensues. If the patient's tolerance is so low that he cannot be given enough carbohydrate to meet the requirements of a maintenance diet and at the same time preserve a safe ketogenic-antiketogenic ratio, then he must be given insulin.

Low Protein Intake.—Too much protein is distinctly harmful to the diabetic patient. Through its specific dynamic action it stimulates metabolism, and thus violates the important rule of minimal metabolism; and in yet another way it seems to interfere with the utilization of sugar. The experiments of Wilder[3] and his associates lead them to conclude that the harmful effects of too much protein are due not primarily to the added burden of its sugar-forming and ketogenic fractions, but to some other more specific action of protein "the result of which is to interfere with the mechanism of sugar utilization." For these reasons we endeavor today to maintain nitrogen equilibrium at the lowest level which is consistent with nutritive safety.

At the same time, it must not be forgotten that a certain amount of protein is essential. This is somewhat more than is necessary to meet the minimal requirement, for it should always include a reasonable factor of safety. It is believed by many clinicians that for an adult diabetic patient 0.66 Gm. of protein per kilogram of body weight represents the proper allowance. Joslin thinks that in long continued diets except those for elderly patients and for persons with impaired kidneys, a somewhat more liberal allowance is safer, say 1 Gm. per kilogram. Children require more protein than adults, and a daily allowance of at least 1 Gm. per kilogram, sometimes more, is advisable.

Ketogenic-antiketogenic Ratio.—The fat quota of the diet must be kept within the figure permitted by this ratio (see page 315). Violation of this rule may occur in many ways: (*a*) by carelessly permitting an excessive fat intake, (*b*) by ignoring the possibility of an endogenous supply of fat or (*c*) by failing to substract from the apparent carbohydrate supply that which was lost in the urine.

To adopt the formula devised by Woodyatt is, I believe, wise: the fat in the diet, expressed in grams, may equal twice the carbohydrate plus one-half the protein. Joslin leans toward this ratio. A few other experienced clinicians, notably Newburgh and his associates, and Wilder, permit higher ratios. The high fat diets will be more fully discussed below. True, when the total caloric intake is low, the protein allowance restricted and the urine sugar-free, it is probably all right to permit an amount of fat which is three times the carbohydrate allowance. As a rule, however, it is best to give insulin and then increase the carbohydrate as the fat is increased.

Good Hygiene.—While hygiene may appear to have no place in a book on nutrition, it cannot be ignored; for without good hygiene all dietary rules may be useless.

It is surprising how completely a diabetic person's metabolic equilibrium may be upset by the most trivial circumstances. Worry, fright, a fit of anger, a sprained ankle, an attack of tonsillitis—any of these may upset the whole program and undo the benefit of weeks of careful dietary regulation. Emphasis should be laid on the harmful effects of nervous strain; diabetic children should not be permitted to strive for honors in school. The beneficial effects of a reasonable amount of exercise is always to be kept in mind.

Education.—The intelligent cooperation of the patient is essential; to secure this he must be taught the nature of his disease and the objects of treatment. He must be taught to compute food values, to recognize the signs of impending disaster, such as acidosis or insulin shock, and to feel his own responsibility. He should appreciate the fact that gross violation of the rule may mean serious trouble or even death. The necessity for a reasonable degree of precision in the arrangement of the diet should be insisted on; scales are, as a rule, necessary in the beginning; those made for this purpose by John Chatillon and Son are good. After a time these can usually be dispensed with, and the cruder measures, such as "tablespoonful," "average helping," and the like, can be adopted, but these should be used with a reasonable regard for accuracy, and not with slovenly carelessness. Hospitalization is usually of advantage during the first one to three weeks of treatment; discipline, education and clinical investigation can all be carried out best in an institution. This, however, is by no means essential.

The responsibility for the arrangement of the diet, the administration of insulin, the examination of the urine and the general regulation of the patient's life should ordinarily rest on the patient himself, but in exceptional cases some other member of the family may take over this duty. Diabetic children, as young even as 11 or 12 years have proved themselves capable of accepting such responsibility. Blood sugar estimations are of value to the physician, but they can easily be dispensed with in the routine management of the case. In fact, as experience grows, we are learning to depend less on repeated blood examination and more on routine urinalysis. During the first days of tolerance determination, three or more specimens of urine should be examined daily. Later one urinalysis daily, and still later, when tolerance has been established, less frequent examinations will suffice. When, however, there is question as to how well the patient is doing, several specimens of urine passed at different times of the day should be examined.

DETERMINATION OF TOLERANCE

There is no universal criterion by which we can gauge satisfactorily the gravity of each case. It is the custom to classify these cases as mild, moderately severe or severe according to the tolerance for carbohydrate. Such a classification may be misleading, however, in that a patient with a low carbohydrate tolerance on a properly adjusted diet may pursue an entirely satisfactory course and show gradual improvement; while, on the other hand, another diabetic patient with an apparently good tolerance may pursue a stormy course with frequently alarming ketosis. An unwillingness to cooperate, intercurrent infections, an unfortunate temperament or a weakness toward gross dietary indiscretions—any of these may make of the apparently mild case one of great severity. With reservations, however, we can adopt carbohydrate tolerance as a basis on which to construct the diet.

After the patient's tolerance has been tentatively determined, he is placed on a regimen adjusted to this tolerance and, usually with the aid of insulin, the amount of food allowed is gradually increased until a maintenance diet is reached which is not accompanied by glycosuria; such a diet should in caloric value be from 10 to 20 per cent below the calculated metabolic requirement. There are several methods of procedure. That described below follows the method suggested by Joslin.

1. A subcalorie diet should be arranged, approximately from 30 to 50 per cent below the calculated normal, in which there is included (*a*)

protein to the extent of 0.66 Gm. per kilogram of body weight, (*b*) carbohydrate equal to about one-half the former intake and (*c*) a relatively small amount of fat. In a person weighing 70 kilograms such a diet would be represented by the following: carbohydrate, 125 Gm., protein 45 Gm., fat, 40 Gm. (calories 1,020).

2. Each day the carbohydrate content of this diet should be gradually reduced, the protein and fat being kept at approximately the same figure. If the patient continues to show sugar in the urine, the protein and the fat should also be reduced but at a lesser rate.

3. When sugar disappears from the urine this reduction process should be stopped, and with or without the aid of insulin, the food should be increased gradually until an adequate maintenance diet is reached. In this "return process" the carbohydrate should be increased slowly and the fat more rapidly, care being taken always to keep the fat well within the antiketogenic ratio. The protein should always be kept low, but it is best to increase it eventually to 1 Gm. per kilogram of body weight. The patient's tolerance is as a rule increased during this process, and the reappearance of a trace of sugar often merely demands that the diet be kept stationary for a few days; at other times slight carbohydrate curtailment at this point is necessary.

If an adequate maintenance diet cannot be reached without the reappearance of sugar, insulin must be used. The administration of insulin will be discussed on page 338.

4. If the urine persistently shows sugar in spite of continued step by step food reduction as indicated in "2," eventually without further reduction, insulin must be given; the procedure suggested in "3" should then be followed. If time permits, the diet of the refractory case should be reduced to a carbohydrate content of about 40 Gm. before insulin is begun. To save time, however, the "building up" process with the aid of insulin may be begun earlier.

For the convenience of the physician and in order to insure uniformity of procedure in the hospital ward, Joslin has formulated the series of "test diets" and "maintenance diets" given on page 324.

The practical application of these test diets is simple. The patient is first given "T.D. 1;" if glycosuria persists, he tries T. D. 2, then T. D. 3; he rarely needs to try T. D. 4. As a rule, he becomes sugar-free on T. D. 3 or 4. When sugar disappears from the urine, he is placed on a maintenance diet containing a corresponding amount of carbohydrate. Shortly thereafter he is permitted to step up one in the scale of diets. This stepping up is continued until sugar reappears or until a maintenance diet of satisfactory caloric value is reached. If

TABLE 1.—*Insulin Diabetic Diets**

Diet		Total Diet				Carbohydrate (C)						Protein and Fat (PF)					
		Carbo-hy-drate	Pro-tein	Fat	Calo-ries	5 % Vege-tables	Orange	Oat-meal	Shred-ded Wheat	Uneeda	Potato	Egg	Cream 20 % Fat	Ba-con	But-ter	Meat	Diet
Test . . .	T. D. 1	181	46	44	1,304	300	300	. .	3	4	240	3	120	. .	. .	. . .	1
	T. D. 2	101	35	43	931	300	300	. .	1	2	120	3	120	. .	. .	. . .	2
	T. D. 3	66	24	37	693	300	300	. .	½	2	. . .	2	120	. .	. .	. . .	3
	T. D. 4	34	15	30	466	300	200	. .	. .	. .	. . .	1	120	. .	. .	. . .	4
Mainte-nance	C 1 + PF 1	14	15	30	386	300	. . .	. .	. .	. .	. . .	1	120	. .	. .	. . .	1
	C 2 + PF 2	22	19	37	497	300	100	. .	. .	. .	. . .	2	60	. .	15	. . .	2
	C 3 + PF 3	32	24	37	557	600	100	. .	. .	. .	. . .	2	60	. .	15	. . .	3
	C 4 + PF 4	42	29	52	752	600	200	. .	. .	. .	. . .	2	60	30	15	. . .	4
	C 5 + PF 5	52	32	66	930	600	200	15	. .	. .	. . .	2	60	30	30	. . .	5
	C 6 + PF 6	64	44	83	1,179	600	200	30	. .	. .	. . .	2	120	30	30	30	6
	C 7 + PF 7	74	52	88	1,296	600	300	30	. .	. .	. . .	2	120	30	30	60	7
	C 8 + PF 8	84	61	94	1,426	600	300	30	. .	2	. . .	2	120	30	30	90	8
	C 9 + PF 9	98	65	106	1,606	600	300	30	½	2	. . .	2	180	30	30	90	9
	C10 + PF10	109	66	119	1,771	600	300	30	1	2	. . .	2	180	30	45	90	10
	C11 + PF11	135	80	135	2,075	600	300	30	1	2	120	2	240	30	45	120	11
	C12 + PF12	159	84	135	2,187	600	300	30	1	2	240	2	240	30	45	120	12

* This table is taken from Joslin, E. P.: J. Metab. Research **2**: 651, 1922.

glycosuria reappears before a diet of requisite energy value has been reached, say at C_7 + P. F.$_7$ (calories 1,296), the carbohydrate may be reduced to C_6 and the protein and fat kept at P. F.$_7$, or the latter may be increased to P. F.$_8$ or P. F.$_9$, or the fat alone may be increased by the addition of cream, butter or bacon. On such restricted diets the tolerance usually shows a gradual increase; in fact, it is on this ability of the organism to regain its tolerance that this method is based. If an adequate maintenance diet cannot be reached without the appearance of sugar, then insulin must be given, and the diet further increased until the requisite number of calories is provided.

Other Methods of Procedure.—Other methods are sometimes preferable. Frequently it is desirable, as has been emphasized by Paullin, to proceed more rapidly, and in such instances the patient may be given at the outset a diet which closely approximates the maintenance requirement, and, in rapidly increasing doses, sufficient insulin to enable him to utilize this amount of food. A concrete example is given by Woodyatt.[10]

> Different cases present different problems and no one stereotyped procedure has proved equally effective in all. When a new case presents for management, the history and the first inspection and examination of the case permit one to judge of the type and degree of the diabetes and these determine the initial procedure. For illustration, assume that the patient is a young man of 30, that he looks emaciated and has the peculiar translucent pallor suggestive of a severe diabetes. He states that he has had the disease to his knowledge for only one year, that a year ago he weighed 160 pounds. Now he weighs 110 pounds. The disease has disabled him in a year. Unless the emaciation is attributable to enforced undernutrition such a case is obviously one of inherently severe diabetes. By diet adjustment alone nothing short of rigid restriction promises to restore him to the non-diabetic status. In such a case there would seem to be no object in temporizing with intermediate diets. He is placed at once on a simple measured ration containing 0.5 to 0.8 Gm. protein and 2.0 to 2.5 Gm. fat per kg. of body weight plus the least amount of carbohydrate that can be given without making the diet unpalatable; for example:

	Gm.	Carbohydrate, Gm.	Protein, Gm.	Fat, Gm.	
Cream, 20 per cent	400	20	12	80	
Eggs	2	..	12	12	
Bacon	30	..	5	15	
Butter	20	...	..	17	
Total	...	20	29	124	Calories, 1,312

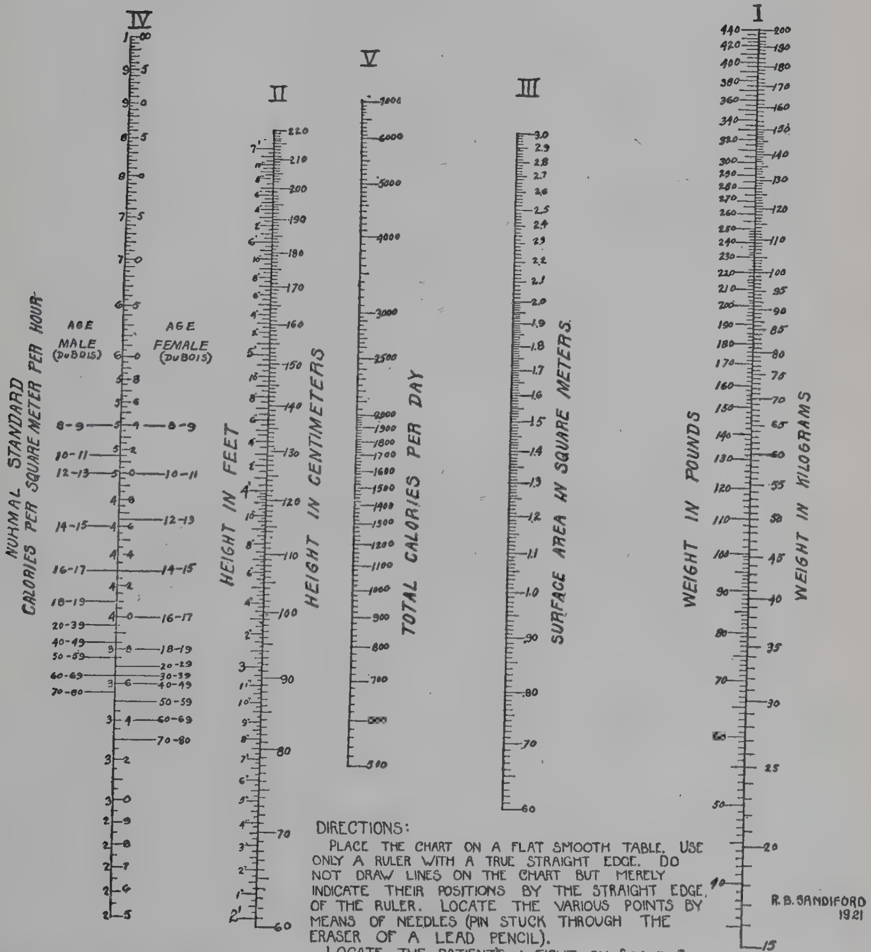
> At bed rest this suffices for caloric maintenance of the 50 Kg. patient and commonly for a nitrogen balance. The glucose value of the diet estimated as C + .58 P + .1 F is 49 Gm. On this diet either the urine becomes sugar-free or it does not. If it becomes

sugar-free the diet is increased sufficiently to give it a glucose value some 25 Gm. higher, i.e., to 74 Gm. or thereabouts. If this produces no gross glycosuria the diet is advanced again, and so on. Either on the initial diet or a later one there occurs a steady excretion of 15 to 25 Gm. of glucose per day and one learns by the difference between the glucose supply and the glucose excretion the number of grams utilized per day, i.e. the existing tolerance "T" or the power to burn glucose. Having established a steady excretion of, say 10 to 25 Gm. of glucose per day, the probable dose of insulin necessary to check it can then be calculated. It has been our experience that 1 unit will account, directly, for 1.0 to 1.5 Gm. of glucose.

The author then describes the manner in which stepwise both food supply and insulin are increased until maintenance with freedom from glycosuria is established. It will be noted that the antiketogenic-ketogenic ratio of the diet is high—2.6. However, when the protein and caloric intake are low and conditions are satisfactory, such diets are often well borne. This method in the hands of an experienced clinician saves time and has other advantages, but it presupposes certain technical knowledge and diabetic experience that is not always available. It should as a rule be used only when the patient is under good supervision and when the physician is experienced in the technical details of diabetic management.

Another method of procedure is that proposed by Wilder in the use of his nomographic charts. These will conveniently give the basal metabolic requirement as well as the proper amounts of carbohydrate, protein and fat. He assumes for reasons already given that the total caloric value of the diet should be about 20 per cent lower than the calculated total metabolic requirement for the normal person. Since the activities of the patient in the ward or about the house would ordinarily demand an addition of 10 per cent to the basal requirement, and the specific dynamic action of the food another 10 per cent, he assumes that if, without compensating for this 20 per cent increment, we merely take the calculated basal metabolism as the correct total energy requirement for the diabetic, we shall then have, as stipulated, a food supply which is actually 20 per cent below the normal requirement. If the patient is engaged in a sedentary occupation, from 20 to 30 per cent should be added to this figure. This author feels that it is of such importance to approximate closely the correct figure that instead of taking body weight as a criterion it is best to follow the Du Bois surface area standard and calculate basal metabolism from the four factors, age, sex, height and weight. This is done by means of the basal metabolic chart of Boothby and Sandiford (page 327). Given the total caloric requirement as determined by this chart, the food requirement in terms of carbohydrate, protein and fat can then be calculated on the "diabetic diet chart" devised by Wilder (page 328). These charts furnish a convenient method for rapid calculation and are useful in hospital and clinic. The objection to the use of the second chart, however, is that, like all such plans, it does not permit the physician to individualize; I fear that it is a mistake for the physician to follow any plan which provides him too conveniently with ready-made calculations. He must know something of the rationale of the

DIABETIC DIET CHART I *



DIRECTIONS:

PLACE THE CHART ON A FLAT SMOOTH TABLE. USE ONLY A RULER WITH A TRUE STRAIGHT EDGE. DO NOT DRAW LINES ON THE CHART BUT MERELY INDICATE THEIR POSITIONS BY THE STRAIGHT EDGE OF THE RULER. LOCATE THE VARIOUS POINTS BY MEANS OF NEEDLES (PIN STUCK THROUGH THE ERASER OF A LEAD PENCIL).

LOCATE THE PATIENT'S WEIGHT ON SCALE I AND HIS HEIGHT ON SCALE II. THE RULER JOINING THESE TWO POINTS INTERSECTS SCALE III AT THE PATIENT'S SURFACE AREA. LOCATE THE AGE AND SEX OF THE PATIENT ON SCALE IV. A RULER JOINING THIS POINT WITH THE PATIENT'S SURFACE AREA ON SCALE III CROSSES SCALE V AT THE REQUIRED TOTAL FOOD CALORIES FOR BASAL MAINTENANCE.

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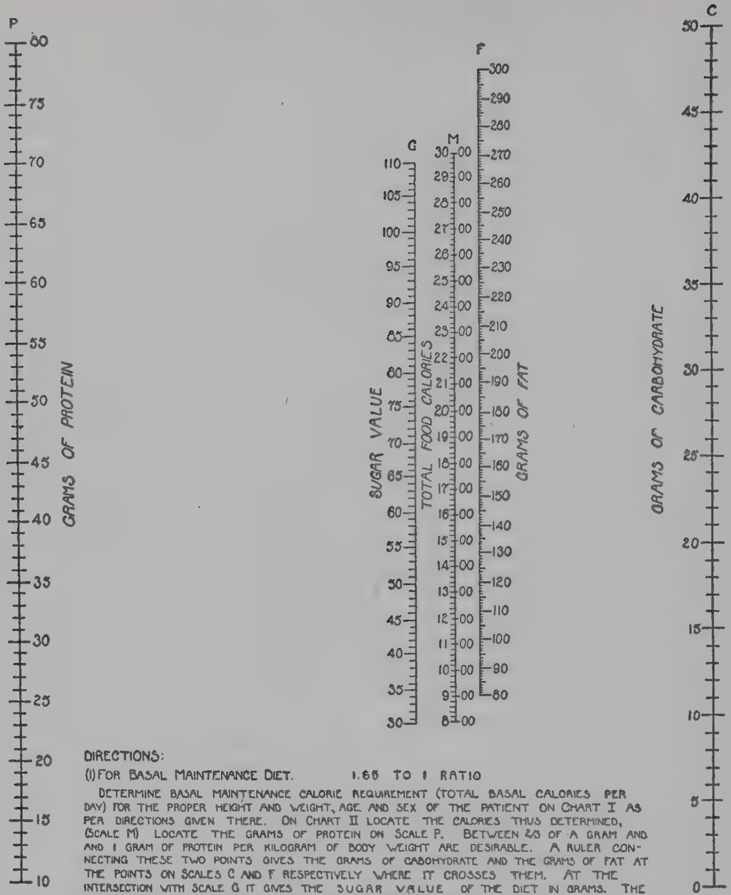
* Copies of these charts may be obtained from H. N. Elmer, 1641 Monadnock Bldg., Chicago.

DIABETIC DIET CHART II



DIRECTIONS:

(1) FOR BASAL MAINTENANCE DIET. 1.65 TO 1 RATIO

DETERMINE BASAL MAINTENANCE CALORIE REQUIREMENT (TOTAL BASAL CALORIES PER DAY) FOR THE PROPER HEIGHT AND WEIGHT, AGE AND SEX OF THE PATIENT ON CHART I AS PER DIRECTIONS GIVEN THERE. ON CHART II LOCATE THE CALORIES THUS DETERMINED, (SCALE M) LOCATE THE GRAMS OF PROTEIN ON SCALE P. BETWEEN 2/3 OF A GRAM AND AND 1 GRAM OF PROTEIN PER KILOGRAM OF BODY WEIGHT ARE DESIRABLE. A RULER CONNECTING THESE TWO POINTS GIVES THE GRAMS OF CABOHYDRATE AND THE GRAMS OF FAT AT THE POINTS ON SCALES C AND F RESPECTIVELY WHERE IT CROSSES THEM. AT THE INTERSECTION WITH SCALE G IT GIVES THE SUGAR VALUE OF THE DIET IN GRAMS. THE FOOD MIXTURE THUS ESTIMATED HAS A KETOGENIC-ANTIKETOGENIC RATIO OF 1.65 TO 1.

(2) FOR MAXIMUM CALORIE DIET (INSULIN).

HAVING DETERMINED ON SCALE G THE SUGAR VALUE OF THE BASAL MAINTENANCE DIET, ADD THE NUMBER OF GRAMS OF GLUCOSE TO BE BALANCED BY INSULIN. LOCATE THIS VALUE ON SCALE G. ANY STRAIGHT LINE INTERSECTING SCALE G AT THIS POINT AND CROSSING THE OTHER SCALES WILL GIVE A DIET THAT HAS A KETOGENIC-ANTIKETOGENIC RATIO OF 1.65 TO 1.

procedure and of the basis on which food calculations are made; he should be able always to recalculate and to readjust the diet as circumstances demand.

It should be noted that the diets prescribed by Wilder's chart are high in fat. This author assumes as safe a ketogenic-antiketogenic ratio of 2:1, but, to be conservative, he stays well within this figure by adopting in these charts a ratio of 1.65:1.

DIET FOR MAINTENANCE

For maintenance, the diet should be from 10 to 20 per cent below the calculated normal; it should prevent both overnutrition and marked undernutrition. It should be emphasized that to permit the patient, through the aid of insulin, to become moderately fat, or even to increase his weight beyond the normal is to court disaster; he should be fed for energy, not for body weight. His food should be sufficient to provide him with energy to carry on comfortably and without exhaustion such daily activities as his occupation and circumstances demand, and sufficient insulin should be given to permit the economical utilization of this amount of food.

The protein of the maintenance diet should be kept within narrow limits. For a long continued diet it is probably unsafe to provide per kilogram of body weight less than 0.66 Gm. or more than 1 Gm. of protein.

Differences of opinion exist as to the relative amounts of carbohydrate and fat which should appropriately be prescribed in the maintenance diet. Since insulin will permit the utilization of any reasonable amount of carbohydrate, and since the high carbohydrate diet is easier to take and more nearly approaches the normal, this type has the greatest appeal. The amount of carbohydrate, as a rule, should be from 90 to 150 Gm., in some cases even more. Fats are prescribed in amounts sufficient to bring the total caloric value of the food to the required figure. The average diabetic diet contains proportionately two or three times as much fat as is taken in health. It is necessary merely that a safe ketogenic-antiketogenic ratio be observed.

The Construction of the Maintenance Diet.—This admits of genuine skill. The carbohydrate quota should never be taken in concentrated form; a large part should be in the form of 5 per cent and 10 per cent vegetables, and a smaller part in 15 per cent vegetables and fruits. Vegetables are of definite value in giving the necessary bulk to the food. If the amount of carbohydrate permitted is liberal, oatmeal, potatoes and even bananas may be included. Crackers, such as Uneeda Biscuits, which are of known weight, may also be included. Bread should seldom be permitted; it is objectionable not only because it is high in starch, but also because it is extremely difficult to regulate accurately the amount eaten. Substitutes for bread made of washed bran with the addition of "Cellu" flour often form an agreeable addition to the diet. No sweets should be permitted except in the form of fruits, preferably as orange juice. Protein may be taken in almost any form, but proteins of high biologic value such as are found in meat, eggs, milk and cheese are to be preferred. Fats are most agreeably taken in the form of cream (20 per cent) and butter. All of it, however, should not be taken in this form, but bacon and eggs should be added, and when a high fat content is desired, olive oil.

Intarvin is a synthetic fat which because of its odd number of carbon atoms is believed not to produce ketosis and therefore to be less harmful than other fats. Dr. Kahn,[11] who devised it, states that Intarvin "is absorbed to about 90 per cent and is catabolized in the bodies of diabetic patients without the production of ketones." McCann[12] and his associates, after clinical experiment, adopted the view that it is less ketogenic than ordinary fat, but they add that this evidence is not entirely conclusive. They do not regard it as of great value to the diabetic patient because of its intensely disagreeable taste when taken in large amounts. It would appear that Intarvin has not filled the place originally claimed for it.

The food of the diabetic patient should be easy to obtain, simple and digestible. The diet should be constructed as far as possible of articles which are of easy availability and which are commonly found in the normal menu; rare unseasonable foods and those difficult to obtain should be avoided. Even specially prepared diabetic dishes should be resorted to only to avoid monotony. The food should never be highly seasoned; seasonings not only blunt the taste for good food, but they possibly exert an unfavorable effect on the pancreas. When economy in nutrition is striven for, as in diabetes, those foods which throw the least burden on the digestive organs are to be preferred. On the other hand, the food should not be concentrated, for a bulky diet with an abundance of unabsorbable residue gives a grateful sense of comfort and also stimulates peristalsis. Unwholesome foods should be avoided because a digestive upset in the diabetic patient usually means loss of tolerance with return of glycosuria, possible ketosis and uncertainty as to the amount of food actually metabolized.

The menu should provide sufficient variety. Elasticity in the choice of food is essential, else the diet will become monotonous, and the patient will be tempted to break over. To insure variety he must be able to compute his own diets and must have sufficient familiarity with foods to make the necessary substitutions. He must be familiar with the market in order to avail himself of the variety of products which the different seasons offer. Campbell[13] calls attention to the advisability of making use for variety's sake of non-nutrient substances, mushrooms, broths and mineral oil mayonnaise. He also makes the following pertinent suggestion:

> In constructing the first draft of a menu it is unnecessary to use up all the protein, fat or carbohydrate assigned to any one meal, in that meal. Some slight latitude may be allowed if the whole day's ration approximates the correct total. Indeed it is often

somewhat better to use slightly less than the prescribed amount of food, leaving a margin to be used as extras to vary the diet. Vegetable salad tastes very different when enriched by the addition of a portion of lobster, a ball of cottage cheese, a sardine or a shrimp, or a small slice of Canadian cheese. Salted almonds or chopped nuts may be added to a fruit salad. The actual caloric value of these extras is almost inconsiderable, but they are of immense importance in increasing the palatability of the diet.

A warning should be given against the numerous diabetic foods. The trouble here is twofold: 1. While the statement of the manufacturer as to carbohydrate content is today in most instances accurate, there are a few instances in which the claims are grossly misleading. 2. The protein content of such foods even if known, is likely to be disregarded by the patient, with the result that in taking these foods in relatively large amounts he greatly exceeds his protein allowance. I have two patients whose frequent return of glycosuria was difficult to explain until investigation revealed that they were eating large amounts of diabetic biscuits; these were given them at a diabetic spa as being entirely innocuous, but it was found that the protein contained in them supplied glucose greatly in excess of the patient's tolerance and thus produced the glucosuria. It is infinitely better that the patient confine himself to ordinary foods of known value.

OTHER METHODS OF MANAGEMENT

High Fat Diets.—Before the discovery of insulin, Newburgh and Marsh,[14] impressed by the inadequacy of prevalent diets, devised and were bold enough to put into use their high fat diet. They argued with good reason that the high protein, low fat, low carbohydrate diet was faulty in that it either failed to eliminate glycosuria or, if this was accomplished, it was inadequate to meet the patient's total caloric needs and therefore brought about a state of grave inanition. They were among the first to point out the harmful effects of too much protein. They insisted that with an extremely low carbohydrate intake and a minimum of protein there could safely be taken a very large amount of fat without danger of acidosis. In order to prove that their procedure was an improvement over the older diets, they proposed to show for it the following advantages: "(1) that glycosuria is avoided in severe diabetics; (2) that this diet does not precipitate acidosis; (3) that nitrogen equilibrium is maintained, and (4) that the patients are able to lead at least a moderately active, comfortable life." They discussed the effect of this diet in seventy-three cases (without selection) of true diabetes mellitus. These patients gained in strength, showed no alarming acidosis, and all remained sugar-free while under treatment. In subsequent publications these authors discussed the beneficial influence of this diet on the blood sugar and expressed themselves as satisfied with its adequacy and safety.

The procedure outlined by these workers is as follows:

> When a patient enters the clinic, he is placed on a diet containing from 900 to 1,000 calories, of which about 90 Gm. is fat, 10 Gm. is protein and 14 Gm. is carbohydrate. After the patient has been sugar free for one or two weeks, his diet is increased to about 1,400 calories, of which 140 Gm. is fat, 28 Gm. is protein and from 15 to 20 Gm. is carbohydrate. In the case of small individuals this diet is sufficient for prolonged use, and some of them are discharged with instructions to continue it. For larger persons, after another period of trial, a second increase is made, reaching 1,800 calories, containing 170 Gm. of fat, from 30 to 40 Gm. of protein, and from 25 to 30 Gm. carbohydrate. Further additions up to 2,500 calories may be made to suit individual cases.

Newburgh and Marsh report a highly satisfactory experience with their high fat diets. It has been suggested that these results can be attributed to two factors: to relative undernutrition and to rigid restriction of protein. These workers have contributed important material to our knowledge of diabetic dietaries and have done pioneer work. Specifically, they have taught us that protein restriction is essential to the satisfactory treatment of persons who have diabetes and that larger amounts of fat than was formerly thought possible can be safely taken under such circumstances. Today, however, there are certain objections to be seen in the high fat diet. Joslin offers the pertinent comment that it requires a great deal more intelligence to follow without violation the low carbohydrate, high fat diet than the high carbohydrate low fat regimen. The penalty for breaking over the former is infinitely more serious; if the patient exceeds his already liberal allowance of fat and at the same time takes too much protein, coma and death may be the penalty; while if with the other type of diet he exceeds his carbohydrate allowance, probably nothing more immediately serious than glycosuria results. It is much more difficult, too, to live comfortably on the high fat diet during a long period of years. As a final argument against the use of large amounts of fat, it is evident that since the discovery of insulin we can prescribe with impunity much larger amounts of carbohydrate than was formerly the case, and thus are able to provide for the diabetic patient adequate nourishment without resorting to the expedient of Newburgh and Marsh.

Fasting.—Many of the earlier students of diabetes recognized the value of fasting; I recall that in 1907 it was a frequently used expedient in the clinic of Friederich Müller. To F. M. Allen, however, belongs the credit for recognizing the value of prolonged fasting as a means of raising the patient's tolerance, and of popularizing this method of treatment. His work represents a definite advance in diabetic therapy. Fasting was very popular for a few years just prior to the advent of insulin. The patient was given no food for periods of one, two, three and even five or six days; he was given an abundance of fluids, water, clear broths and coffee, but nothing of nutritive value; originally whisky was prescribed. The fast was stopped when he became sugar-free. The object of this procedure was to rest the pancreas and thus to raise the patient's tolerance. Since the discovery of insulin, however, fasting is no longer necessary and is seldom used.

The Oatmeal Cure of Von Noorden.—This method prescribed that the patient take daily from 200 to 250 Gm. of oatmeal, to which was added from 200 to 300 Gm. of butter and occasionally a few eggs. With this treatment von Noorden achieved results which in that day were highly satisfactory. No one has been able to demonstrate, however, that the diabetic patient oxidizes the carbohydrate of oatmeal any better than other carbohydrate. Joslin suggests that the good results of the oatmeal cure could probably be attributed to the low protein intake and to the fasting or semifasting which was a part of the treatment. Other carbohydrate cures have been suggested, but since the advent of insulin, all of these have been placed in the discard.

DIABETES IN CHILDREN

The principles which should govern the diet of the diabetic child are in general those which hold good for adults with diabetes. Four points of difference, however, should be kept in mind: 1. Because of his rapid growth, the child needs more protein than the adult; not less than 1 Gm. per kilogram of body weight, at times even more. 2. The margin between hyperglycemia and hypoglycemia in the child is a narrow one; it is relatively easy to give too much insulin and without warning to produce insulin shock. 3. The disease is more likely to be progressive in the child, and therefore requires closer attention. 4. Nervous influences play an even greater rôle in juvenile diabetes than in that of the adult.

The dietary standards given by Holt and Falles for the normal child may be taken as a criterion of nutritive requirement (page 220 and 221). It should be borne in mind, however, that these standards apply to active healthy children who take an enormous amount of exercise, and that, since the activities of the youthful diabetic patient are somewhat restricted, they should be discounted accordingly. Moderate undernutrition, as with the adult, is to be desired.

An emaciated diabetic child when placed on an appropriate diet and given insulin will sometimes exhibit extremely rapid growth; such a child may within a surprisingly short time reach his normal stature and weight. Allen has commented on the frequency with which diabetic patients who are liberally fed (with the aid of insulin) tend to become obese; children of this type have an appearance somewhat suggestive of myxedema or of dystrophia adiposo-genitalis. On the other hand, when properly nourished, diabetic children grow normally and develop the proper musculature and strength.

Certain details of the child's diet should be kept in mind. Because of his small stature, small amounts of food have relatively greater influence; therefore in making additions to the diet, the small size of the patient should always be kept in mind. The food should be simple and of such nature as children ordinarily take (see chapter on diet of the normal child). Today we give very young children more vegetables than was formerly customary, which makes much easier the arrangement of the diabetic child's diet. Joslin advises against the use of saccharine because he feels that the taste for sweets should not be encouraged; sweets should be forgotten.

Geyelin[1] favors a high carbohydrate diet. In support of this, he points to the work of Bainbridge[15] which indicates that insulin is much more effective in rats fed on a high carbohydrate diet than in those fed on a high fat ration. He calls attention to the fact that less insulin per gram of carbohydrate is necessary when the carbohydrate is increased, and expresses the opinion that the success of this type of diet is not alone in the increased carbohydrate but also in low fat intake. This author runs the daily carbohydrate allowance for children up to 200 Gm., 300 Gm. and even as high as 350 Gm. The insulin must of course be increased, but in his experience not in proportion to the increase in carbohydrate. For illustration,[16] he assumes that a child is receiving a diet of: carbohydrate, 70 Gm.; protein, 73 Gm., and fat, 150 Gm., for which a total of from 40 to 45 units of insulin is needed.

Change this diet to 250 Gm. of carbohydrate, 70 Gm. of protein, and 70 Gm. of fat, and, while some increase in insulin becomes necessary, an additional 10 to 20 units will suffice, in the experience of Geyelin, to take care of the large amount of carbohydrate added.

Insulin should be given children with even greater caution than has been advised for adults; the initial dose should be from one-fourth to one-half unit, after which it may be increased as with adults, but at a relatively slower rate. It is increased until the patient be comes sugar-free. Then the carbohydrate of the food is increased until glycosuria reappears, at which time more insulin is added. The recurrence at intervals of both glycosuria and insulin shock is almost inevitable in the treatment of diabetic children. The increase in carbohydrate and total caloric intake should be stopped when the patient shows a continuous gain in weight and height, with positive nitrogen balance, and when he indicates that his appetite is being satisfied.

Geyelin[16] states that on a high carbohydrate diet insulin shock will be much less frequent and the diurnal blood sugar curve much lower than on the high fat diet. The fact that the high carbohydrate diet is more agreeable to the patient gives some assurance that it will be more accurately observed. He also believes that with children high protein feeding (2 or perhaps 3 Gm. per kilogram) is advisable, and regards this as responsible for the rapid growth and gain in weight observed in his patients.[1]

Joslin[17] holds views directly opposed to those just quoted. He feels that the high carbohydrate diet for children advocated by Geyelin is a mistake, and advises for the child much the same type of dietary management as is prescribed for the adult.

SURGICAL INTERVENTION IN DIABETES

Insulin has robbed diabetic surgery of its terrors. The properly treated diabetic patient may be operated on today with no more risk than ordinarily attaches to similar operations under other circumstances. There has been a feeling in the past that an excessive hyperglycemia interferes with the healing of wounds and predisposes to infection. Experience would indicate that this is not true.

Promptness in operating on a diabetic patient is just as necessary as with any other surgical patient; valuable time should not be lost by unnecessarily prolonging the period of preparation. This applies with especial force to diabetic gangrene, when time means everything; even hours count heavily. If time permits, three things should be accomplished in preparation for operation: 1. The patient's tissues should be supplied with a superabundance of fluids. Water and other liquids by mouth and by proctoclysis is advisable; hypodermoclysis may be necessary. 2. Since an adequate store of glycogen is good insurance for the recovery of any patient, the effort should be to induce the diabetic patient who is being prepared for operation to store as much glycogen as possible; this is accomplished by permitting a liberal carbohydrate intake. 3. Sufficient insulin should be given to enable the patient to oxidize this quantity of carbohydrate and thus to guard against acidosis. As a rule, he requires more insulin at this time than at other times.

Blotner and Fitz,[18] in reporting their experience in the use of insulin in diabetic gangrene, emphasize the fact that the proper use of insulin in this complication is as important as is the proper use of insulin in the treatment of diabetic coma. They write:

> With insulin we see patients made free of acidosis and prepared for operation in a few hours and able to eat an adequate diet shortly after operation as a result of which they gain weight and strength, resist infection and recover from their illness in a rapid and gratifying fashion.

Both before and after operation simple foods in reasonably liberal amounts should be given; the sudden restriction of carbohydrate should be avoided. Orange juice, oatmeal gruel, cream of wheat and milk are carbohydrate foods which may be depended on. Vegetable purees are also valuable. Both prior to and following the operation there is likely to be transient glycosuria. It is unwise at such a time to curtail drastically the diet in an effort to get rid of this sugar. As the tolerance increases and the patient recovers, the sugar will usually disappear. This applies also to infections which are independent of surgical measures.

Regarding the anesthetic, it should be noted that gas oxygen does not carry the dangers of either chloroform or ether, and that it is therefore greatly to be preferred. Ethylene anesthesia is also reasonably safe. The shorter the period of anesthesia, the better.

TREATMENT OF DIABETIC COMA

Treatment of a patient in coma has been revolutionized by insulin. The failure of carbohydrate to burn causes poor oxidation of fat; this in turn, through the production of ketone bodies, leads to acidosis; and marked acidosis is often accompanied by coma. Insulin, through the increased oxidation of glucose, puts a stop to this vicious train of events. Formerly diabetic coma was almost invariably fatal, but today we are able to relieve and apparently cure a large number of these patients provided the coma is not of too long standing. The disturbed chemistry of the body, whether through acidosis or otherwise, if permitted to persist long, however, eventually leads to irretrievable changes in the nerves, myocardium and other structures.

Coma should not be permitted to occur. Joslin regards it as a preventable accident. With insulin we should be able in all properly managed cases to forestall its advent. In undertaking the treatment of persons in diabetic coma or threatened with coma certain precautions should be observed: (*a*) Be sure that the patient actually has diabetic coma (not insulin shock or apoplexy!). (*b*) Keep him at rest in bed, and sufficiently warm. (*c*) Insist that some one person, preferably a nurse, be in constant attendance, who is responsible for the faithful carrying out of orders.

The recognition of coma or impending coma is not always easy. A pronounced fall in the carbon dioxide combining power of the blood and a marked ferric chloride reaction in the urine are highly significant signs. One must learn, however, to depend in addition on certain premonitory clinical signs, such as lack of appetite, nausea, vomiting, a dry glazed tongue, sluggishness and somnolence. Campbell[19] emphasizes the fact that evidences of dehydration are always present, and says that "a patient with a tongue moist at the edges is relatively safe for several hours at least."

The early recognition of threatening coma accompanied by the prompt administration of relatively large doses of insulin will usually ward off disaster. In coma and in the precomatose stage the ordinarily observed carbohydrate equivalent of insulin does not hold good; these patients take large doses of insulin without experiencing hypoglycemia. At the first sign of coma, 20, 30 or perhaps 40 units of insulin should immediately be given. An hour later if the urine obtained by catheter still contains sugar, another 30 or 40 units should be given; thereafter it should be continued at the rate of 10 units every hour as long as the urine contains sugar or until the patient is beyond danger.

When the patient is already comatose, even more energetic measures are demanded; the insulin at this stage can with advantage be given intravenously. Forty units as the first dose, then an hour later 30 or more units; thereafter 10 or 15 units hourly as above advised. Larger doses are frequently given; Campbell[19] often gives 100 units as the initial dose. Insulin sometimes has a delayed effect, and it has been said that in giving very large doses frequently repeated there is the danger that relief of the acidosis may be quickly followed by hypoglycemia. If the precaution is taken, however, to administer at the same time relatively large amounts of glucose, 1 Gm. to the unit, this possibility is easily controlled.

It is important that the patient have sufficient sugar to metabolize. The juice of two or three oranges will furnish the sugar; if the patient is nauseated, Karo corn syrup well diluted may be given by rectum, or pure glucose may be given intravenously. When coma is present or imminent, everything depends on promptness and rapidity of action, and, immediately following the first dose of insulin, glucose should be given intravenously—from 500 to 1,000 cc. of a 5 per cent solution, according to the amount of insulin administered; thereafter corn syrup may be given by rectum. It has been argued that with a surplus of sugar circulating in the blood the giving of glucose is unnecessary. The perilous nature of unchecked acidosis, however, warrants the administration of such amounts of glucose as will permit of heroic doses of insulin. This insures the prompt oxidation of generous amounts of glucose, and therefore the rapid destruction of the offending ketone bodies. The possible harm which the unnecessary administration of glucose might do to the pancreas is inconsiderable as compared to the benefits to be achieved from the prompt and certain oxidation of a large amount of carbohydrate.

To prevent the harmful effects of dehydration, large quantities of water should be given. A glass of water every half hour should be insisted on. If the patient is nauseated or is comatose, constant proctoclysis or salt solution (1,000 cc.) subcutaneously or intravenously is imperative. Since it is not the function of this book to consider therapeutic measures which have no bearing on diet, we can omit discussion of alkali in diabetes. Many diabetic specialists feel that in proper dosage benefit accompanies such therapy; others, notably Joslin, feel that no good is thereby accomplished and that actual harm may follow.

INSULIN

In July, 1921, Banting[20] injected into a partially depancreatized dog a watery extract made from the pancreas of another dog whose pancreatic duct had previously been ligated, and witnessed a fall in the animal's blood sugar from 0.2 to 0.12 per cent. He demonstrated that with the aid of this extract the animal was able to metabolize an increased quantity of sugar. Subsequent observations were made on human diabetic patients by Banting and Best in the clinic of Duncan Graham at the Toronto General Hospital, and the clinical value of this extract in diabetes was proved. It was given the name "insulin."

The process of manufacture was perfected (method of J. B. Collip) so that it has become possible to secure a potent, protein-free, watery extract from the islands of the adult beef pancreas. It is in this form that insulin now appears on the market.

The Standardization of Insulin.—This is based on its effect on the blood sugar of a rabbit weighing 2 kg. which has fasted twenty-four hours. Its potency is expressed in units; one unit is one-third the amount of insulin necessary to reduce within three to five hours the blood sugar of such a rabbit to 0.045 per cent, the point at which convulsions occur. Insulin is placed on the market for clinical use in vials of varying strength, labeled U5, U10, U20 and U40. The figure which follows the letter "U" indicates the number of units in 1 cc. of that preparation; thus "U5" carries 5 units to 1 cc., "U20," 20 units to 1 cc., etc. The vials as a rule contain 5 or 10 cc. Care must be taken not to confuse units with cubic centimeters.

The Effect of Insulin.—The effect of insulin is to make possible the oxidation of sugar. "In human beings after the administration of Insulin two separate and distinct phenomena have been observed; first, an increased utilization of carbohydrate in diabetics; and secondly, in both diabetics and normals, a lowering of the blood sugar level." Insulin restores to the diabetic person the thing which he lacks, the ability to metabolize sugar. In both diabetic and nondiabetic persons, it reduces blood sugar; if the dose is large enough, the sugar content of the blood may fall to such a point that grave effects and even death may ensue. (This condition of Hypoglycemia and its treatment will be discussed later.) Through its influence on carbohydrate metabolism insulin also facilitates the oxidation of fat; for when more carbohydrate is utilized, the fat is more completely burned and the ketone bodies cease to appear. In this manner insulin will relieve acidosis and prevent coma.

> In particular, glycosuria is abolished, ketones disappear from the urine and blood, the blood sugar can be maintained at a normal level, the respiratory quotient rises, showing carbohydrate utilization, the alkali reserve and alveolar carbon dioxide of patients in acidosis and coma return to normal.[20]

The Glucose Equivalent of Insulin.—This cannot be expressed by a fixed figure. Many circumstances, some of them unknown, govern the amount of glucose which can be oxidized with the aid of 1 unit of insulin. The Toronto investigators,[21] in making their patients aglycosuric, found that 1 unit of insulin was equivalent to from 1 to 1.5 Gm. of glucose. The estimates of other investigators approximate these figures: Joslin,[22] 2 Gm. of glucose; Woodyatt,[10] from 1 to 1.5 Gm.; Wilder, Boothby and associates[23] from 1.5 to 2 Gm.

The Dosage of Insulin.—The dosage depends chiefly on the severity of the disease and to some extent on certain other factors. Sufficient should be given to enable the patient to take a maintenance diet and remain aglycosuric. Joslin and his associates[24] report that in series of eighty-three diabetic patients selected because of the severity of the disease, the average daily insulin dosage was 11 units. Four of these patients received, respectively, 63, 45, 30 and 20 plus units daily; with these exceptions, none of the others received more than 20 units daily. Allen and Sherrill,[25] in May, 1923, found that, disregarding emergencies, the actual daily insulin dosage of their patients varied between 4 and 70 units. They state that for severe cases they have found it necessary to give from 30 to 50 units. With further experience and cheaper insulin, we are leaning toward the larger doses, say for moderately severe and severe cases from 30 to 60 units daily. Certain factors other than the severity of the disease may help determine the dosage. For instance, in severe acidosis and coma enormous amounts may be demanded; in septic states, greatly increased doses of insulin are usually necessary. More is required to gain weight than for mere maintenance. "When the blood sugar is high, and consequently there is a larger amount of tissue sugar, a larger amount of insulin is required to make the patient aglycosuric than is necessary to maintain him in this condition."[26]

Insulin should be administered at first in small doses, because it is impossible to predict in any case its full influence on the blood sugar. Even very small amounts have produced alarming hypoglycemia. It is preferably given about one-half hour before a meal. Joslin begins with three doses daily; first 1 unit, then 2 units and then 3 units. If glycosuria persists, he increases stepwise on the following days until the patient is taking 5 units three times daily. Thereafter it is increased or decreased as the state of the urine and the need for carbohydrate demand. Examinations of the urine passed at different hours of the day should serve as a guide for the readjustment of the diet and the regrouping of the several doses of insulin. The transient appearance of sugar at a certain time of the day may be anticipated by an increased dose of insulin and this increase compensated for if possible by a corresponding reduction of the dose scheduled for some other period; or, without disturbing the amount of insulin, the carbohydrate allowance for the day may be redistributed so as to lessen the burden at the critical point. By such maneuvering, the frequency of administration of insulin can usually be reduced to twice and sometimes to once daily. As a rule, large amounts of insulin should be divided into three doses. Joslin usually gives two doses daily; in 90 per cent of his cases Woodyatt gives one dose daily. The usual rule is a half hour before breakfast and supper if it is taken twice, or before breakfast if once.

Can the patient look forward to reducing the insulin dosage or stopping it altogether? This depends largely on the nature of the case. Many patients who began treatment with insulin are now living comfortably without it. The great majority have found it necessary to continue it; but many of these, after the first few weeks, have been able to reduce the dose; some, because of the progressive nature of their disability, have been forced to increase the dose. A warning should be given against the ill advised omission of insulin; for disaster, not immediately apparent, may ensue. The reduction should be gradual before actual omission is attempted. If the available supply of insulin is suddenly cut short, the diet should be drastically curtailed, particularly as to its fat content.

The Technic of Administration.—The technic is simple, but accuracy and cleanliness is demanded. Insulin is given subcutaneously. Rarely, when the patient is comatose, it may be given intravenously.* The patient or a member of the family preferably the former, should be taught to give the injections and to vary the dose as the state of the urine and other circumstances may demand. The dosage should be expressed always in units, never in cubic centimeters. For this purpose special syringes graduated in units have been placed on the market. I prefer to use the usual 2 cc. Luer syringe graduated in tenths. It is a simple matter for the patient, knowing the strength of his insulin preparation, to measure his dosage. Needles of 25 to 29 gauge, from three-fourths to one inch in length are preferred. Syringe and needle should be boiled in the usual manner before use. The injection should be made into the loose, subcutaneous areola tissue. It should not be made into the skin, for this will produce pain and a possible scar; to avoid this, the precaution should be taken to see that the point of the needle is freely movable under the skin before the injection is made. The physician should assure himself before delegating treatment to the patient that the latter thoroughly understands certain things: (*a*) how to boil and aseptically handle the syringe and the needle, and the necessity therefor; (*b*) the accurate measurement of dosage; (*c*) the technic of subcutaneous injection, and (*d*) the nature and treatment of insulin shock.

The Place of Insulin in the Treatment of Diabetes.—This should be clearly understood. Insulin should be taken as an adjunct to dietary regulation and in no sense as a substitute. The patient must depend first on careful dietary management and then, if necessary, avail himself of insulin. Under no circumstances should insulin be used in large amounts merely to permit the patient to indulge his appetite ad libitum or to put on body weight in excess of the minimum standard (Luxus Insulin). On the other hand, he should not be deprived of its energy-giving effects merely because he can by rigid dietary discipline manage to stay sugar-free and at the same time maintain a poor sort of nutritive equilibrium. He should receive enough insulin to enable him to meet comfortably his needs for energy and to experience a fair sense of well-being. Body weight should be kept somewhat below the normal figure; insulin should be given primarily for the production of energy, not for gain in weight. In the effort to improve the condition of the diabetic person patience should be exercised, for progress in this disease must be made deliberately, not hastily.

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* Insulin has been prepared in the form of hypodermic tablets which have the advantage of keeping indefinitely in any climate; they have not yet come into general use. Campbell and others have rubbed it into the shaved skin and noted some effect (Campbell, W. R.: Insulin, Medicine **3**: 243, 1924). It may be used in this way, as he suggests, to prolong its action in patients who require only small doses, and to secure a sense of well being.

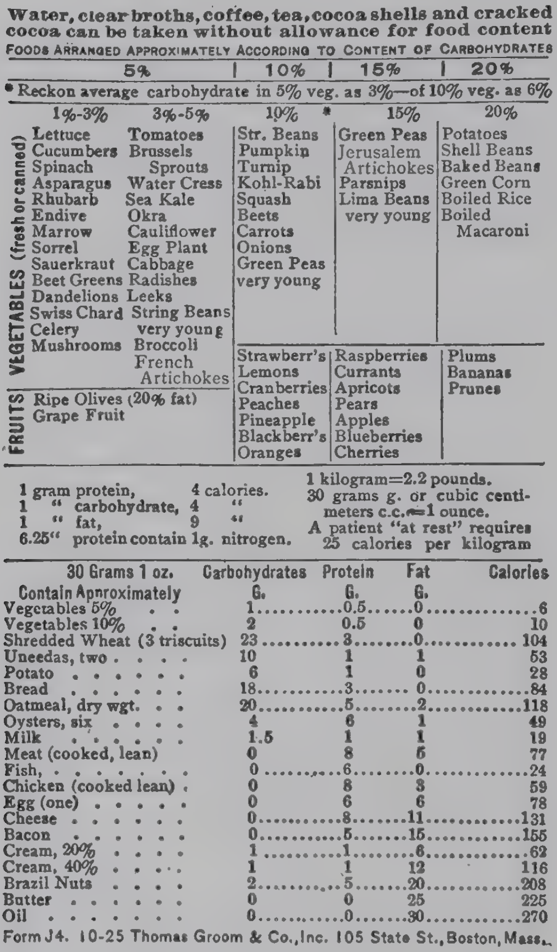
Insulin Shock.—Shock accompanies the hypoglycemia which follows an overdose of insulin. Banting and Best found that with a marked fall in blood sugar certain characteristic symptoms were exhibited by the rabbit: first, hunger, thirst, hyperexcitability and fear; then, when a blood sugar level of 0.045 per cent was reached, convulsions. They were able to control the convulsions by the subcutaneous injection of glucose. Insulin produces in man a similar train of symptoms. When the blood sugar is reduced to say 0.07 or 0.06 per cent, there is a feeling of nervousness, uneasiness, tremulousness, weakness and excessive hunger. The pulse is rapid and often there is a characteristic facial expression with dilated pupils. The patient learns to recognize promptly the nature of these symptoms and to terminate them by taking carbohydrate; or they may cease spontaneously. Usually, however, the hypoglycemia if uncorrected proceeds to the production of more alarming symptoms—sweating, flushing, pallor, emotional upset, fainting, diplopia and incoordination. With a further fall of the blood sugar, there may be aphasia, confusion, delirium, convulsions and coma.

The extent of the hypoglycemia determines as a rule the severity of the reaction. The Toronto[27] investigators state that many patients recognize that something is wrong when the blood sugar is between 0.08 and 0.09 per cent, but that other patients experience no symptoms at a level as low even as 0.05 per cent. They have observed a mild reaction at 0.04 per cent, and, on the other hand, a reaction of great severity at 0.06 per cent. They state that a blood sugar content of 0.035 per cent usually produces unconsciousness. Mild insulin shock often occurs in the course of treatment when: (*a*) the insulin is being increased too rapidly, or the frequency of dosage is being readjusted; (*b*) the food supply is reduced without coincident reduction in insulin; (*c*) the tolerance for carbohydrate increases; or when (*d*) a radical change in the patient's manner of living upsets the glucose-insulin balance (increased exercise). In many clinics it is the custom purposely to give the patient a mild insulin shock so that he will thereafter readily recognize oncoming danger.

The treatment of hypoglycemia and the accompanying reaction is simple. The danger is that insulin shock will develop unrecognized or that it will be mistaken (inexcusably) for diabetic coma. Glucose, preferably as orange juice, will cause a prompt rise in blood sugar and relief of symptoms. Corn syrup or any sugar will suffice. If the patient will take the juice of two oranges, a few pieces of candy, or a few lumps of sugar the symptoms will promptly disappear. To prevent a recurrence, the dose of insulin should be reduced or the amount of carbohydrate in the previous meal should be increased.

Severe shock demands similar remedies even more promptly administered. If the patient is unconscious, Karo corn syrup should be given by rectum and glucose solution intravenously. About 200 cc. of a 5 per cent solution of glucose is the proper intravenous dose, but stronger solutions may be given in smaller amounts. In some diabetic clinics, sterile ampules of 20 per cent glucose solution are kept for such emergencies. Epinephrine is a rapidly acting antidote to hypoglycemic shock, though it will not serve as a substitute for carbohydrate and therefore should be immediately followed by glucose. One cubic centimeter of a 1:1,000 solution of epinephrine should in urgent cases be given subcutaneously while preparations are being made for the administration of glucose.[28]

The data given below were assembled by Joslin and placed on a small card which may conveniently be given the patient.[1]



Water, clear broths, coffee, tea, cocoa shells and cracked cocoa can be taken without allowance for food content

FOODS ARRANGED APPROXIMATELY ACCORDING TO CONTENT OF CARBOHYDRATES

5% | 10% | 15% | 20%

* Reckon average carbohydrate in 5% veg. as 3%—of 10% veg. as 6%

	1%-3%	3%-5%	10% *	15%	20%
VEGETABLES (fresh or canned)	Lettuce Cucumbers Spinach Asparagus Rhubarb Endive Marrow Sorrel Sauerkraut Beet Greens Dandelions Swiss Chard Celery Mushrooms	Tomatoes Brussels Sprouts Water Cress Sea Kale Okra Cauliflower Egg Plant Cabbage Radishes Leeks String Beans very young Broccoli French Artichokes	Str. Beans Pumpkin Turnip Kohl-Rabi Squash Beets Carrots Onions Green Peas very young	Green Peas Jerusalem Artichokes Parsnips Lima Beans very young	Potatoes Shell Beans Baked Beans Green Corn Boiled Rice Boiled Macaroni
FRUITS	Ripe Olives (20% fat) Grape Fruit		Strawberr's Lemons Cranberries Peaches Pineapple Blackberr's Oranges	Raspberries Currants Apricots Pears Apples Blueberries Cherries	Plums Bananas Prunes

1 gram protein, 4 calories.
1 " carbohydrate, 4 "
1 " fat, 9 "
6.25" protein contain 1g. nitrogen.

1 kilogram=2.2 pounds.
30 grams g. or cubic centimeters c.c.=1 ounce.
A patient "at rest" requires 25 calories per kilogram

30 Grams 1 oz. Contain Approximately	Carbohydrates G.	Protein G.	Fat G.	Calories
Vegetables 5%	1	0.5	0	6
Vegetables 10%	2	0.5	0	10
Shredded Wheat (3 triscuits)	23	3	0	104
Uneedas, two	10	1	1	53
Potato	6	1	0	28
Bread	18	3	0	84
Oatmeal, dry wgt.	20	5	2	118
Oysters, six	4	6	1	49
Milk	1.5	1	1	19
Meat (cooked, lean)	0	8	5	77
Fish,	0	6	0	24
Chicken (cooked lean)	0	8	3	59
Egg (one)	0	6	6	78
Cheese	0	8	11	131
Bacon	0	5	15	155
Cream, 20%	1	1	6	62
Cream, 40%	1	1	12	116
Brazil Nuts	2	5	20	208
Butter	0	0	25	225
Oil	0	0	30	270

Form J4. 10-25 Thomas Groom & Co., Inc. 105 State St., Boston, Mass.

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[1] These and other useful cards are published by Thomas Groom and Co., Inc., 105 State St., Boston.

The following are sample menus which I have found suitable for diabetic patients of varying degrees of tolerance. Appropriate changes and substitutions should be made as indicated in the foregoing.

Unless otherwise indicated 20 per cent cream is used.

Menus for Diabetic Patients

I.	Carbohydrate	Protein	Fat	Calories
BREAKFAST:				
1 small orange	10			
1 heaping tablespoonful of boiled oat meal	6	2		
4 tbsp. cream	2	2	12	
½ tbsp. (level) butter	..	..	6	
1 soft boiled egg	..	6	6	
	18	10	24	328
DINNER:				
2 h. tbsp. spinach	3	2		
2 strips crisp bacon	..	3	8	
Buttered asparagus, about 5 stalks	4	2		
Small size tomato salad with vinegar	4	1		
1 tbsp. butter	..	..	13	
	11	8	21	297
SUPPER:				
1 shirred egg and 1 white with 2 crisp st. bacon	..	9	14	
2 h. tbsp. stewed tomatoes	3	1		
2 h. tbsp. baked egg plant	3	1		
Average sized lettuce salad with vinegar or lemon juice	2			
1 small orange, sliced	10			
½ tbsp. butter	..	..	6	
	18	11	20	296
Total	47	29	65	921

II.	Carbohydrate	Protein	Fat	Calories
Breakfast:				
½ small orange	5			
1 large saucer dry oat meal cooked	20	5	2	
1 scrambled egg with 2 strips of crisp bacon	..	8	14	
4 tbsp. cream	2	2	12	
½ tbsp. butter	..	..	..	
	27	15	34	474
Dinner:				
Small serving roast beef very lean	..	11		
Average helping string beans	5	1	1	
A. h. cauliflower	3	1		
Asparagus salad (4 or 5 stalks) on leaf of lettuce with vinegar	4	2		
Orange cup made with 1½ small orange	15			
1½ tbsp. butter	..	..	19	
	27	15	20	348
Supper:				
Fluffy 1 egg and 1 white omelet with 2 strips bacon	..	9	6	
A. h. stewed celery	3	3	8	
A. h. cabbage or greens	3			
1 average sized tomato sliced	4	1		
½ tbsp. butter	..	..	6	
Lemon jello, made with Genesee diabetic Jello powder and 4 tablespoonfuls cream or plain lemon jello sweetened with saccharin	2	2	12	
	12	15	32	396
Total	66	45	86	1,218

III.	Carbohydrate	Protein	Fat	Calories
BREAKFAST:				
1 medium sized grape fruit	10			
1 large saucer dry oat meal cooked	20	5	1	
1 shirred egg with 2 strips crisp bacon	..	8	14	
4 tbsp. cream	2	2	12	
½ tbsp. butter	..	..	6	
	32	15	33	485
DINNER:				
A. h. lean roast lamb	..	15		
A. h. buttered carrots	6			
A. h. egg plant and oysters, en casserole	5	3	8	
Spinach salad with 1 teaspoonful mayonnaise	3	2	6	
Spanish cream with 1 tablespoonful whipped cream	1	6	8	
1 tbsp. butter	..	..	13	
Lemonade or tea	15	26	35	479
SUPPER:				
Buttered asparagus (5 stalks)	3	2		
Served on plate with 2 strips crisp bacon	..	3	8	
A. h. brussels sprouts or cabbage	3	1		
A. h. buttered beets	6	2		
Fruit salad, made with ½ grape fruit	15	1		
and 1 medium sized orange with cream dressing	1	1	8	
½ tbsp. butter	..	..	6	
	28	10	22	350
Total	75	52	90	1,314

	Carbohydrate	Protein	Fat	Calories
IV.				
BREAKFAST:				
1 small orange	10			
1 large saucer oat meal dry, cooked	20	5	2	
1 egg scrambled with 2 h. tbsp. canned tomatoes and served with 2 strips crisp bacon	3	10	14	
6 tbsp. cream and ½ tablespoonful butter	3	3	24	
	36	18	40	576
DINNER:				
1 a. h. tenderloin steak, no fat, with mushroom sauce; 2 Uneeda biscuits	10	25	1	
A. h. buttered onions	6	1		
2 h. tbsp. squash	6	1		
Tomato aspic salad with 1 teaspoonful mayonnaise	1	2	6	
Butter 1 tbsp. peach whip	6	1	19	
	29	30	26	470
SUPPER:				
1 shirred egg	..	6	6	
2 strips crisp bacon	..	3	8	
Average sized tomato stuffed with celery and baked	3	1		
A. h. buttered okra or greens	3	1		
Spinach salad with 1 tbsp. mayonnaise	3	2	10	
Orange sherbert	13	1	6	
	22	14	30	414
Total	87	62	96	1,460

	Carbohydrate	Protein	Fat	Calories
V.				
BREAKFAST:				
1 a. s. orange	10			
½ Shredded wheat biscuit	11	2		
2 strips crisp bacon 2 tablespoonful stewed tomatoes	3	3	8	
1 egg omelet	..	6	6	
6 tbsp. cream 2 teaspoonful butter	3	3	18	
	27	14	32	452
DINNER:				
A. h. Spanish mackerel with lemon or beef	6	21	6	
A. h. string beans 2 Uneeda biscuits	10	1	1	
A. h. buttered asparagus	4	2		
Medium sized beet and egg (½) salad with ½ tablespoonful mayonnaise	6	3	3	
			10	
Fruit cup; 1 average size orange with 2 heaping	10			
tbsp. strawberries; 1 tablespoonful butter	4	1	13	
	40	28	33	573
SUPPER:				
9 or 10 panned oysters, served with	6	9	2	
2 strips crisp bacon on hot plate	..	3	8	
A. h. buttered carrots	6	1		
A. s. tomato salad with vinegar	3	1		
A. h. Spinach with ½ hard boiled egg	3	3	3	
Baked egg custard with	1	4	8	
2 tbsp. cream	2	2	6	
1 tbsp. butter	..	..	13	
Bed time 1 orange	10			
	31	23	41	545
Total	98	66	106	1,610

	Carbohydrate	Protein	Fat	Calories
VI.				
BREAKFAST:				
½ large grapefruit	10			
1 shredded wheat biscuit	23	3		
1 poached egg with 4 strips crisp bacon	..	11	21	
8 tbsp. cream ½ tablespoonful butter	4	4	30	
	37	18	51	679
DINNER:				
1 a. h. chicken white meat no fat	2	32	4	
A. h. egg plant and osyter en casserole	5	4		
A. h. stringbeans; fruit salad with cream dressing	19	2	8	
2 Uneeda biscuits	10	1	1	
Diabetic (Genesee) jello with 2 tablespoonful cream	1	1	6	
1 tbsp. butter	..	..	13	
	37	40	32	596
SUPPER:				
1 Egg souffle with 2 strips bacon	..	8	13	
	6	1		
A. h. buttered carrots; average helping squash	6	1		
A. h. tomato salad with vinegar	3	1		
1 Uneeda biscuit	5	1	1	
Peach whip	6	1	7	
1 tbsp. butter	..	..	13	
	26	13	34	462
Total	100	71	117	1,737

	Carbohydrate	Protein	Fat	Calories
VII.				
BREAKFAST:				
1 medium sized orange, sliced	10			
1 large saucer raw oat meal, cooked	20	5	2	
1 egg omelet with 4 strips crisp bacon	..	11	21	
8 tbsp. cream, ½ tbsp. butter	4	4	30	
	34	20	53	693
DINNER:				
Fruit cup ½ each orange and grapefruit	10			
A. h. roast beef or fish; average helping buttered onions	6	24	1	
Cauliflower en casserole	3	3	4	
Carrot salad	6	..	10	
Spanish cream, served with 2 tablespoonful whipped cream	2	7	16	
1 tablespoonful butter; 2 Uneeda biscuits	10	..	13	
	37	34	44	680
SUPPER:				
1 lamb chop; *no fat*	..	6		
and 2 strips bacon	..	3	8	
A. h. buttered carrots	6	1		
A. h. string beans	6	1		
Egg salad (1 hard boiled egg and 2 tsp. peas) 1 tsp. mayonnaise	2	7	12	
1 tbsp. butter; 1 biscuit	7	1	13	
Orange sherbert	13	1	6	
Bed time ½ orange	5			
	39	20	39	587
Total	110	74	136	1,960

Sample Diet Given by Campbell[13]

FOOD	AMOUNT	C. Gm.	P. Gm.	F. Gm.	
Ration		41	47	146	
Meal		13+	16	49	
Breakfast					
Grapefruit	150 gm.	7.5	....	....	
or orange	75 gm.				
Eggs	2 gm.	....	12	12	
Bacon, cooked	20 gm.	....	3	8	
Cream, 32 per cent	50 c.c.	1.9	1	16	
Butter	15 gm.	....	....	12.7	
Tea, coffee, bran cakes		....	....	....	
		9.7	16	48.7	
Lunch					
Soup cream, 32 per cent	50 c.c.	3.4	1	16	
Celery	50 gm.				
Boiled ham	40 gm.	....	8	8.8	
Salad (radish, lettuce, tomato, cucumber)	170 gm.	5.1	....	....	
Custard (recipe below)	1 gm.	4	4.5	5	
Cream, 32 per cent	50 c.c.	1.9	1	16	
Butter	10 gm.	....	....	8.5	
Tea or coffee, bran cakes, agar jelly, mineral oil mayonnaise		14.4	14.5	54.3	
Dinner					
Soup, clear	100 c.c.	1	....	....	
Roast beef	60 gm.	....	13.8	16.8	
Vegetable, asparagus	100 gm.				
marrow	100 gm.	6	....	....	
Fruit, 10 per cent	85 gm.	8.5	....	....	
Cream 32 per cent	50 c.c.	1.9	1	16	
Butter	12 gm.	....	....	10.2	
Tea or coffee, bran cakes, agar jelly					
		17.4	14.8	43.0	
		41.2	45.3	146	
Extra 10 gm. cottage cheese with salad		0.4	2	....	
Total		41.6	47.3	146	1,670

Pepper, salt and other condiments, q.s.; saccharin, maximum 3 gr. per day.
Butter allowed, 37 gm.
Cream allowed, 200 c.c.

High Fat Diabetic Diet No. 3 (Newburgh & Marsh)

	Carbohyd., Gm.	Protein, Gm.	Fat, Gm.	Calories
Dinner				
Trout, 2 oz	.....	10.26	5.84	93.6
butter, ½ oz	.....	0.14	12.04	108.9
Asparagus salad:				
Lettuce, 1 oz	0.82	0.34	0.09	5.4
Asparagus, 3 oz	2.37	1.29	0.09	15.33
Mayonnaise, 2 oz	.....	.....	42.53	382.6
Celery, 3 oz	.....	0.93	0.09	15.6
Watermelon, 3 oz	5.07	0.33	0.18	25.8
Tea				
Broth				
Supper				
Tomatoes, 4 oz	4.52	1.36	1.24	25.6
with butter, ½ oz	.....	0.14	12.04	108.9
Egg salad:				
Shredded lettuce, 2 oz	1.84	0.68	1.18	10.8
1 hard cooked egg	.....	6.03	4.72	66.6
Mayonnaise, 2 oz. (oil, 1½ oz.)	.....	.....	42.53	382.6
Diabetic Jello	4.1	1.36	.....	21.8
with whipped cream, 2 oz	1.7	1.24	22.68	215.8
Broth				
Tea				
Breakfast				
Omelet, 1 egg	.....	6.03	4.72	66.6
1 egg yolk	.....	2.7	5.0	54.5
Butter, ½ oz	.....	0.14	12.4	108.9
Cream (18 per cent), 2 oz., for coffee	2.8	1.6	11.2	118.4
Broth				
Total	26.24	34.22	176.21	1,827.7

The Following Diabetic Recipes Have Been Found Useful by the Author

	C.	P.	F.	Cal.
Orange Sherbert:				
½ glass orange juice	12			
2 tbsp. 20 per cent cream, sweeten with saccharin and freeze	1	1	6	
	13	1	6	110
Peach Whip:				
6 halves, canned unsweetened peaches	5			
1 tbsp. whipped cream heaping; peel, and mash thoroughly and beat in the cream, sweeten with saccharin	1	1	7	
	6	1	7	91
Spanish Cream:				
1 tsp. gelatin	..	2		
1 tbsp. cold water, soak; when dissolved, add 6 tbsp. water and flavor with sherry or lemon juice. When it begins to jell whip ½ egg white and mix thoroughly and chill	..	3		
		5		20
Baked Custard:				
1 egg	..	6	6	
4 tbsp. 20 per cent cream and 4 tbsp. water or enough to make 2 small custards	2	2	12	
make as usual and sweeten with saccharin	2	8	18	
Each custard contains	1	4	9	101
Tomato Aspic Salad:				
1 tsp. gelatin; soak in 1 tbsp. water	1	2		
Add to small cup or mold of strained tomatoes and add	1	2		
1 tbsp. chopped celery, green pepper, cabbage and seasoning and chill. Serve on lettuce leaf with 1 tsp. mayonnaise made without sugar	..	..	6	74
	1	4	6	
Fruit Salad:				
¼ Grapefruit	2			
1 Medium sized orange	10			
2 or 3 grapes seeded, or strawberries				
	12	..	..	48
Carrot Salad:				
	C.	P.	Cal.	F.
2 h. tbsp. boiled or raw carrots cut small; season; add a bit of celery, onion, and green pepper	6			
Mix with ½ tbsp. mayonnaise	..	..	10	14
Spinach Salad:				
2 h. tbsp. boiled spinach, pressed into mold and chilled; serve on lettuce leaf	3			
	3	..	..	12

	C.	P.	F.	Cal.
CREAM DRESSING:				
1 tbsp. whipped cream; season with salt, paprika and sweeten with saccharin	1	1	7	
	1	1	7	71
PANNED OYSTERS:				
Have pan hot and buttered. Drop oysters which have been drained on pan for few seconds, turn and serve on hot plate. Season and garnish 6 oysters and teaspoonful butter	3	5	9	113
EGG PLANT AND OYSTERS EN CASSEROLE:				
2 h. tbsp. egg plant	3	1		
3 average size oysters, 1 teaspoonful butter; cook egg plant as usual, drain. Chop oysters and mix with egg plant. Season with salt, paprika and butter. Put in individual casserole and sprinkle with 1 teaspoonful cracker crumbs	2	3	8	104
CAULIFLOWER EN CASSEROLE:				
2 h. tbsp. cauliflower boiled as usual; season, put in casserole and sprinkle with 1 tsp. American cheese and 1 teaspoonful cracker crumbs and bake	..	6	7	99

LEMON JELLO:

Made as any other. Sweeten with saccharin 1 tsp. gelatin and ½ lemon for 1 serving.

LEMONADE:

Make with ½ lemon and sweeten with saccharin.

Diabetic Recipes Given by Campbell

To Work Bran

Buy unprepared feed bran. Sift to remove remaining flour. Half fill a cotton sack and tie firmly at the top; leave under running water 3 to 4 hours, turning every fifteen minutes, or wash through ten to twelve waters or till water comes quite clear of all starchy appearance. Wring as dry as possible; spread in pans. Dry in a slow oven stirring occasionally. Thoroughly dried bran may be stored indefinitely.

BRAN WAFERS

3 cups dry washed bran
¾ tablespoon India gum
½ teaspoon salt
Hot water

1 teaspoon each of cinnamon and nutmeg and ½ grain saccharin may be added if desired.

Method.—Mix dry ingredients thoroughly; add hot water to make a soft dough. Spread in thin layers on a baking sheet greased with mineral oil. Cut in squares. Bake in a slow oven until dry and crisp. No food value.

MAPLE SYRUP—SUBSTITUTE

2 to 4 Gm. agar
Saccharin
1 C. hot water
⅓ tsp. Mapleine extract

Method.—Dissolve agar by boiling in water. Strain and add saccharine and flavoring. No food value.

Baked Custard

⅓ C.—80 Gm. milk
⅓ egg
Vanilla or nutmeg
Salt, f.g.
¼ grain saccharin
or a few drops of liquor saccharin

Method.—Beat the egg and add flavoring, salt and and saccharin, scalded milk. Pour into a custard cup. Place cup in a pan containing hot water and bake in a moderate oven. Food value: P. 4.5, F. 5, C. 4. May treble the recipe: 1 egg and 1 cup milk and make 3 custards.

Agar Jelly

2 tablespoons agar
4 cups boiling water
Saccharine
Flavoring
Coloring

Method.—Add boiling water to agar and boil until dissolved. Flavor and color and pour into wet molds. Grated rind, orange, lemon or coffee, strained cocoa shells or any diabetic flavoring may be used. No food value.

Thrice-cooked Vegetables

Method.—Prepare the 5 per cent vegetables in the usual way. Place in cold water ½ hour. Add fresh cold water and boil 5 minutes. Repeat this three times, the last time cooking until vegetables are tender. Vegetables may be reheated in a little broth or seasoned with meat extracts. No food value.

Mayonnaise

1 egg
1 tb. mustard
1 tsp. paprika
1 tsp. salt
2 C. mineral oil
2 to 4 tb. vinegar

Method.—Beat egg. Add dry ingredients, continue beating, slowly adding oil. When half oil is added, add vinegar and oil alternately. Dressing should be quite stiff when finished. Food value.—P. 6, F. 6 (negligible when ordinary portions are consumed).

Additional Diabetic Recipes Given by Joslin

Bran Cookies:

Washed bran	2 cups
India gum	1 tablespoonful
Mineral oil	1 tablespoonful

Salt and saccharin to taste.
Ginger, cloves, anise, or caraway seed, ½ teaspoonful, if desired.

Mix dry ingredients and then add bran and mineral oil with enough water to make a stiff dough. Knead with finger tips. Pat out and cut into thin cookies. Bake about forty-five minutes in a moderate oven until crisp.

Cellu-bran Cookies:

Washed bran	2 cups
Cellu-flour	½ cup
India gum	1 tablespoonful
Spice	1 teaspoonful
Mineral oil	1 tablespoonful

Salt and saccharin to taste.

Mix as bran cakes and bake in moderate oven, being careful not to brown cookies.

Cellu-flour Pie Crust:

Cellu-flour	2 tablespoonfuls
India gum	1 teaspoonful

Salt and enough water to make a stiff dough.

Mix with finger tips and shape pie crust as desired before baking, bake in a moderate oven, being careful not to brown.

Cellu-flour Griddle Cakes:

Egg	1
Water	1 tablespoonful
Cellu-flour	1 –2 tablespoonfuls

Salt and saccharin to taste.

Beat white and yolk of egg separately and together add water and cellu-flour, enough to make a fairly firm mixture, salt and saccharin. Fry on a hot griddle and serve with butter allowed in diet or a substitute maple syrup.

Food Value: Carbohydrate, 0; protein, 6; fat, 6.

Cheese Custard:

Egg	1
Milk	120 cc.
Grated cheese	10 Gm.

Beat egg, add pinch of salt, milk and cheese. Beat and bake as two custards in a pan of water in oven.

Irish Moss Blanc Mange:

Soak small amount of moss in cold water ten minutes. Pour off water and add to moss 60 cc. of 40 per cent cream and 120 cc. of cocoa shell liquid. Bring to boil and boil until a drop jellies on a cold plate. Then flavor with vanilla, ½ teaspoonful, and saccharin; strain and mold.

Coffee Spanish Cream:

Dissolve ½ teaspoonful of gelatin in 5 tablespoonfuls of coffee. Pour this on beaten yolk of egg. Add 60 cc. of cream and 60 cc. of milk, saccharin. Cook as soft custard and when thick add to beaten white of egg. This makes two creams. Chill and mold on ice.

Food Value of One Cream: Carbohydrate, 2.5; protein, 5; fat, 10

Ice Cream:

Cream	60 cc.
Milk	60 cc.
Egg	1 cc.

Saccharine and flavoring.

Beat as an egg-nog and freeze. More milk and cream may be added to make enough for two meals; or cream may be used entirely if milk is not allowed in diet.

Food value: Carbohydrate, 5; protein, 10; fat, 20.

*Compilation of Analyses of Diabetic Foods**

Reference	Manufacturer or Agent and Name of Product	Protein, Per Cent	Fat, Per Cent	Carbohydrate		Calories per 100 Gm.
				Starch, Per Cent	Other Carbohydrate, Per Cent	
	FLOURS AND MEALS					
	Herman Barker, Somerville, Mass.					
1919	Barker's Gluten Food "A"	76.95	0.44	2.56	9.84	361
1919	Barker's Gluten Food "B"	73.99	0.51	5.23	10.14	362
1919	Barker's Gluten Food "C"	72.90	0.40	6.39	9.80	360
	Battle Creek Sanitarium Co., Battle Creek, Mich.					
1916-4a	Gluten Meal	26.28	1.02	55.03	8.65	369
1916-4a	Gluten Meal	39.33	0.92	41.12	10.08	370
1914-2q	Gluten Meal 80 per cent	76.61	.....	5.77		
	Callard, Stewart & Watt, London					
1909-3	Casoid Flour	82.50	1.60	none	3.10†	357
1916-4a	Gluten Flour	73.40	.....	none		
	Canada Cereal & Flour Co.					
1919-4b	Gluten Flour	18.58	4.48	43.87	16.94	358
	Cereo Co., Tappan, N. Y.					
1919	Soy Bean Gruel Flour	46.13	18.63	0.90	21.86	443
	The Dieto Food Co., New York City					
1914-2q	Flour, Pure Whole Wheat	13.45	2.11	62.44	11.99	371
	Farwell & Rhines, Watertown, N. Y.					
1913-2p	Cresco Flour	18.10	1.00	57.20	10.20	351
1919	Genuine Gluten Flour 40 per cent	40.47	1.47	37.01	9.42	361
1913	Special Diabetic Food	27.50	2.80	40.00	16.60	362
	Golden Rod Milling Co., Portland, Ore.					
1919	Acme Special Flour	15.13	1.75	61.48	8.56	356
1916-4a	Gluten Flour	14.08	1.25	66.97		
	O. B. Gilman, Boston, Mass.					
1913-2p	Gluten Flour	43.20	2.00	31.40	13.10	369
	The Health Food Co., New York City					
1919	Almond Meal	50.25	15.44	none	18.00	412
1919	Bran Biskue, Gluten Bran	27.65	10.53	33.84	13.90	396
1919	Diabetic Casein Flour (self-raising)	72.25	0.79	none	5.73	319
1919-4b	Gluten Flour 40 per cent	39.21	1.05	37.27	12.99	371
1919	Pronireu (Gluten Griddle Cake Flour)	37.85	1.18	36.56	9.14	345
	Jireh Diabetic Food Co., New York City					
1919-4b	Diabetic Flour	14.82	1.96	50.13	20.69	360
1919-4b	Gluten Flour	14.36	2.08	50.00	21.86	371

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* Taken from report of Connecticut Agricultural Experiment Station, "Food Products and Drugs," Bull. 220, 1919.

† Includes fiber.

Compilation of Analyses of Diabetic Foods (Continued)

Reference	Manufacturer or Agent and Name of Product	Protein, Per Cent	Fat, Per Cent	Carbohydrate		Calories per 100 Gm.
				Starch, Per Cent	Other Carbohydrate, Per Cent	
1906-2e	Wheat and Barley Flour	11.80	1.90	66.20*	7.30	358
	Johnson Educator Food Co., Boston, Mass.					
1911-2k	Educator Standard Gluten Flour	36.60	1.40	40.90	12 80	374
	The Kellogg Food Co., Battle Creek, Mich.					
1916-2s	20 per cent Gluten Meal	24.68	0.92	51.24	14.17	369
1919	40 per cent Gluten Meal, thoroughly cooked	42.98	1.45	33.38	12.00	380
1912-2m	80 per cent Gluten	74.20	0.90	6.20	8.80	365
1919	Pure Gluten Meal	79.12	0.74	2.56	8.74	368
	Lister Bros., New York City					
1919	Lister's Diabetic Flour, self rising	68.31	0.95	none	9.72	321
	Lyster Bros., Whitefield, N. H.					
1915-2r	Casein Flour	84.50	3.60	none	0.37	381
1916-12a	Diabetic Flour	79.25	3.00	none		
	Loeb's Diabetic Food Bakery, New York City					
1919	Gluten Cracker Meal	36.71	10.88	30.66	11.48	417
1919	Pure Gluten Flour	38.76	1.20	38.22	10.30	360
	Maple Leaf Milling Co.					
1919-4b	Gluten Flour	12.66	1.16	61.51	11.52	353
	Pure Gluten Food Co., Columbus, O.					
1919	Hoyt's Gluten Flour over 40 per cent Protein	41.84	1.13	33.19	12.07	359
1919	Hoyt's Gluten Self-raising Flour over 40 per cent Protein	41.50	0.87	33.38	9.72	346
1919	Hoyt's Gluten Special Flour 80 per cent Protein	77.18	1.19	2.81	10.63	373
	Soy Bean Food Products Co., San Francisco, Calif.					
1919	Soy Bean Flour A	41.81	19.44	0.34	24.07	440
1919	Soy Bean Flour B	44.00	14.20	0.76	25.98	411
	Waukesha Health Products Co., Waukesha, Wis.					
1919	Hepco Flour	44.00	19.14	0.90	21.41	438

* Includes water-soluble carbohydrates.

Compilation of Analyses of Diabetic Foods (Continued)

Reference	Manufacturer or Agent and Name of Product	Protein, Per Cent	Fat, Per Cent	Carbohydrate		Calories per 100 Gm.
				Strcah, Per Cent	Other Carbohydrate, Per Cent	
	Wilson Bros., Rochester, N. Y.					
1919	Genteel Brand Flour	29.38	2.39	49.16	6.23	361
1919	Gluten Flour	45.83	2.01	28.63	11.91	364
	SOFT BREADS					
	The Dieto Food Co., New York City					
1914-2q	Dieto Bread, Pure Whole Wheat	8.84	0.36	36.57	11.41	231
	Health Food Co., New York City					
1919	Glutosac Bread	29.75	2.57	29.53	12.26	309
	Jireh Diabetic Food Co., N. Y. City					
1913-2p	Whole Wheat Bread (not fresh)	11.30	0.70	44.90	18.20	304
	Lyster Bros., Whitefield, N. H.					
1915-2r	Casein Bread	36.57	18.38	none	2.49	322
	HARD BREADS AND BAKERY PRODUCTS					
	The Dieto Food Co., N. Y. City					
1914-2q	Dieto Crackers	13.38	9.24	54.84	13.92	409
	Health Food Co., N. Y. City					
1914-2q	Diabetic Biscuit	35.94	8.83	39.77	6.76	409
1919	Glutosac Wafers, Plain	41.04	7.54	25.12	12.09	342
1919	Glutosac Zwieback	28.84	10.53	33.34	15.24	405
	Johnson Educator Food Co., Boston, Mass.					
1913-2p	Educator Gluten Bread Sticks	32.70	7.20	37.50	11.50	392
1911-2k	Gluten Cookies	24.10	16.00	37.80	14.30	449
	BREAKFAST FOODS					
	Dieto Food Co., N. Y. City					
1914-2q	Dieto Nut Cereal	21.63	18.38	39.54	12.28	459
1914-2q	Wheat and Barley Cereal	11.63	2.15	61.42	14.35	359
	Health Food Co., N. Y. City					
1919	Manana Gluten Breakfast Food	44.80	8.69	21.99	12.47	396
1919	Protosoy (cereal)	40.13	18.17	trace	24.88	424
	Pure Gluten Food Co., Columbus, Ohio					
1919	Hoyt's Gluten Breakfast Food, 40 per cent Protein	46.00	1.79	31.39	10.15	366
1919	Hoyt's Gluten Granules, over 40 per cent Protein	43.78	2.59	32.15	10.08	327
	MACARONI, NOODLES, ETC.					
	The Dieto Food Co., N. Y. City					
1914-2q	Whole Wheat Brand Macaroni	13.88	1.14	58.72	14.98	361
	Jireh Diabetic Food Co., New York City					
1913-2p	Macaroni	16.90	0.90	58.80	12.60	361

Compilation of Analyses of Diabetic Foods (Continued)

Reference	Manufacturer or Agent and Name of Product	Protein, Per Cent	Fat, Per Cent	Carbohydrate		Calories, per 100 Gm.
				Starch, Per Cent	Other Carbohydrate, Per Cent	
	Pure Gluten Food Co., N. Y. City					
1914-2q	Hoyt's Gum Gluten Noodles	36.93	1.23	41.82	10.83	369
	NUTS AND NUT PREPARATIONS					
	Dieto Food Co., N. Y. City					
1914-2q	Pine Nuts	36.69	50.02	none	2.76	620
	Jireh Diabetic Food Co., N. Y. City					
1913-2p	Diabetic Pine Nuts (Pignolias)	39.70	49.40	none	3.40	617
	CHOCOLATE AND CHOCOLATE PREPARATIONS					
	Loeb's Diabetic Food Bakery, N. Y. City					
1919	Almond Chocolate Bars	14.88	53.23	5.34	15.55	622
1919	Diabetic Chocolate	14.69	51.74	7.26	15.52	716
	COCOA					
	The Dieto Food Co., N. Y. City					
1914-2q	Dieto Cocoa	23.56	22.93	12.38	26.57	456
	Jireh Diabetic Food Co., N. Y. City					
1906-2e	Diabetic Cocoa	20.60	17.80	32.60*	18.00	445
1906-2e	Diabetic Cocoa	19.10	18.40	29.00*	18.90	434
	MISCELLANEOUS PRODUCTS					
	Dieto Food Co., N. Y. City					
1914-2q	Dieto Baking Powder	......	.....	12.94		
1914-2q	Dieto Barley Coffee	13.19	7.30	17.72	46.15	374
	Gustav Muller & Co., N. Y. City					
1913-2p	Dr. Bouma Sugar-free Fat-milk	2.40	5.30	......	.....	57
	D. Whiting & Sons, Boston, Mass.					
1913-2p	Sugar-free Milk (ave. 3 analyses)	5.70†	7.20	......	trace	88
1919	Sugar-free Milk	6.43†	9.34	......	0.22‡	111

* Includes water-soluble carbohydrates.

† Nitrogen x6.38.

‡ Reducing sugar calculated as lactose.

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CHAPTER XIII

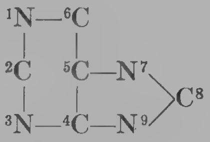
GOUT

METABOLISM IN GOUT

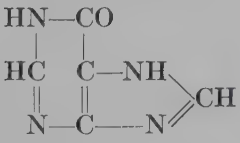
Gout is a disease of metabolism, the salient characteristic of which is the deposition of sodium urate in the tissues. The whole story of this interesting disease has not yet been written, for in spite of a vast amount of experimental work and of valuable additions to our knowledge of the chemistry of uric acid and its precursors, there is much about gout that is still obscure.

Uric acid is a member of that group of compounds known as purin bodies, each of which is built around a certain typical structural formula, the purin ring. Its immediate precursors are the purin bases guanidin, adenin and hypoxanthin, from which it is formed by oxidation. All of these are derived originally from nucleoproteins. The following diagram and the structural formulas will indicate the relationship of these bodies.

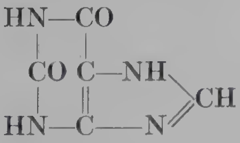
The Purin Nucleus



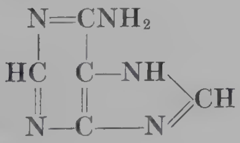
Hypoxanthin (6 Oxypurin)



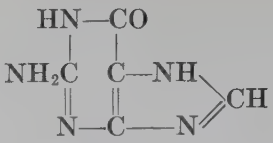
Xanthin (2.6 Dioxypurin)



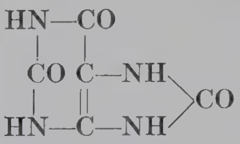
Adenin (6 Aminopurin)



Guanin (2 Amino, 6 Oxypurin)



Uric Acid (2.6.8 Trioxypurin)



The nucleoproteins of the food are split in the stomach into protein and nuclein and from the latter (to a slight extent in the stomach but largely in the intestine) is split off nucleic acid. Nucleic acid is rendered soluble and readily absorbable in the upper intestine, and is absorbed as such or in the form of its immediate derivatives. A further splitting takes place during the passage through the intestinal wall, and the products so formed are carried to the liver. The further stepwise production of a number of degredation products, including tetranucleotids, mononucleotids and nucleosids, is accomplished by as many different ferments. The animo-purins, guanidin and adenin, are deprived of their animo radicles by means of deaminizing ferments, and are finally converted by oxidizing ferments into the oxypurins, hypoxanthin and xanthin. The latter are converted into uric acid by means of an oxydase which in man is found only in the liver. There is good basis for the assumption that uric acid is not destroyed in intermediary metabolism, and that it is a metabolic end-product.* The tissues are capable of storing it in large amounts. It is finally excreted in the urine.

The uric acid of the blood and tissue fluids comes from two distinct sources: from a breaking down of the tissues themselves, the endogenous purins; and from the nucleoproteins of the food, the exogenous purins. A sharp line of distinction has been drawn between these two; for, while the endogenous supply is believed to be fixed and to a certain extent beyond control, the exogenous supply is wholly dependent on the character of the food eaten and therefore can be increased or diminished at will. On a "purin-free" diet the person receives no exogenous purins, and his purin metabolism is limited entirely to the endogenous supply. This distinction between exogenous and endogenous purins loses something in importance, however, when it is considered that the liver and perhaps other organs can store for long periods of time the precursors of uric acid to release them later, and also that the body is able to synthesize nucleoproteins from nonpurin foods and in this manner to augment endogenous purin metabolism. For clinical purposes, however, the distinction between the two is of definite value.

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*This is a disputed point. The work of Folin, Berglund, and Derick (Jour. Bio. Chem., 60, 361, 1924) would indicate that uric acid is destroyed by man to an appreciable extent.

The endogenous purin supply for the same person, while fasting, is probably always approximately the same. It is influenced to a certain extent by the diet even though the food be purin-free, for Folin[1] found that a diet of milk and egg (purin-free but rich in protein!) was followed by a greater excretion of uric acid than one of starch and cream, and Höst[2] has observed that variations in the caloric value of the diet independent of its protein content will influence in like direction the output of endogenous uric acid. Obviously, therefore, when the effort is to lower purin metabolism as in the treatment of gout, care must be taken not only to withhold purin-forming foods from the diet, but to reduce as well its caloric value and protein content.

In health, uric acid as monosodium urate is found in the blood in relatively small amounts. Folin and Denis[3] found from 0.7 to 3.7 Mgm. of uric acid to 100 cc. of blood. McLester,[4] using the colorimetric method of Folin and Denis on fifteen healthy young adults on a purin-free diet, found the uric acid to range from 0.5 mg. to 2.9 mg. in 100 cc. of blood. Subsequent observers have reported similar figures. For the same person on a purin-free diet the observations of McLester as well as those of Höst would indicate that the uric acid content of the blood is fairly constant.

Uric acid is stored in the tissues and organs, and it is probable that the liver is the chief storehouse, which no doubt explains the fact observed by McClure and Pratt[5] that when it is injected into the blood it quickly disappears from the circulation. Pratt views this as an effort on the part of the body to maintain an equilibrium as to uric acid content between blood and tissues; there is reason for believing that in health such an equilibrium holds good.

In gout the uric acid of the blood is, as a rule, increased. Pratt[6] found in eleven cases in which the patients were on an ordinary diet that the uric acid content of the blood varied from 3.1 mg. to 5 mg. in 100 cc. Higher values have been seen: Pratt, 8.7 mg., Fine, 9.5 mg. On the other hand, low values have sometimes been reported, but the method used in these analyses has been questioned. A state of uricemia may be said to exist in gout. This is seen in comparing Pratt's average of 3.7 mg. for gouty patients irrespective of diet with McLester's average of 1.9 mg. of uric acid for fifteen healthy adults on a purin-free diet and Adler and Ragle's[7] average of 1.7 mg. for a much larger series on a mixed diet. As a rule, in health the uric acid content of the blood is from 1 to 3 mg. while in gout it is from 3 mg. to 9 mg. During the gouty attack, the concentration of uric acid in the blood is much greater.

The gouty patient and the person in health show a clear distinction in the manner of their response to an increased exogenous purin supply. If a meal rich in nucleoproteins is taken by a healthy person who has previously been restricted to a purin-free diet, about 50 per cent of this exogenous purin supply will be excreted in the urine in the next one or two days; if the gouty person does this, the excretion is much slower and not more than from 10 to 25 per cent of the exogenous uric acid can be recovered in the urine. In both instances an increase in blood uric acid occurs, but in health this hyperuricemia persists only from twenty-four to forty-eight hours, while in gout it may continue much longer. Pratt regards this tendency of the gouty patient to respond to the introduction of exogenous purins with a sustained rise in blood uric acid as a characteristic feature of the disturbed metabolism of this disease.

It is well known that there is increase in the blood uric acid in diseases other than gout. This is particularly true of early chronic interstitial nephritis, which is taken by some authors to indicate that gout is merely an evidence of renal insufficiency, a view which is not generally accepted.

The urine of the gouty patient on a purin-free diet usually shows a fairly high uric acid content. Such a patient, however, unlike the normal person, is unable to respond to a high purin diet with an increased uric acid output even though he is suffering from hyperuricemia. Just previous to the gouty attack the uric acid output usually falls to a very low level, and then as the attack develops it rises to a high figure, to fall gradually a little later. Phenylcinchoninic acid (atophan, cinchophen), through direct action on the kidney, causes a greatly increased excretion of uric acid both in health and in gout. The purin bodies of the tissues are evidently drawn on, for the output of uric acid under influence of this drug, greatly exceeds the total amount present in the blood.

NATURE OF GOUT

The nature of gout is not clear; two of its manifestations particularly are wanting in satisfactory explanation. Why is uric acid retained in abnormal quantities in the tissues and blood? What determines the localized deposition of sodium urate in the cartilage and other tissues?

In an effort to answer the first question it has been suggested that gout is merely an expression of renal incompetency. True, there is delayed excretion of uric acid, but gout has additional characteristics which serve to distinguish it clearly from those other diseases which are accompanied by hyperuricemia; and, too, in many cases there is ample evidence that the kidneys are competent. It may be that the liver is in some measure at fault, for this organ serves as a storehouse for purin bodies and, under influences which are not thoroughly understood, releases them into the general circulation. Kraus thinks that disturbances of vegetative nervous control acting on this function of the liver may play an important rôle. Since uric acid is dependent for its solubility to some extent on the colloids of the body fluids, the additional suggestion has been made, that in the gouty patient this body exists in a colloid combination which is hard to split and which therefore renders excretion especially difficult. Another theory assumes that in this disease there is a special affinity of the tissues for uric acid, an increase in the uric acid "receptors."

The deposition of urates in the cartilage is determined in part by local conditions. According to Gudzent, uric acid exists in two isomeric forms, as "lactam" and "lactim" urates, the former being readily soluble but unstable, the latter soluble with difficulty but stable. This theory assumes that in gout the less soluble lactim form predominates and that conditions in the cartilage favor its deposition. Perhaps, on the other hand, the sodium of the cartilage renders the monosodium urate of the blood less soluble and thus favors its deposition at this point; perhaps other chemical or physicochemical conditions, normal or abnormal, such for instance as the state of colloids, determine the solubility of these salts and occasion their immediate deposit. The most plausible explanation is that since serum colloids appreciably influence the solubility of sodium urate, conditions may obtain in the joints and other tissues which interfere with the protective influence of these colloids and thus force the deposition of urates.

The acute attack is probably precipitated when the liver suddenly throws into the circulation large quantities of uric acid. The inflammation which occurs around gouty joints and which gives such great pain represents merely a reaction of the tissues to the accumulation of urate.

THE DIET

During *the acute attack* the diet should be greatly restricted. The relatively short duration makes it safe to curtail the diet to a much greater degree than is feasible in chronic gout. The patient should be given purin-free food in which is included small quantities of milk, cereals, white bread with butter, preserves, fruits and an abundance of lemonade and fruit juices. Baked custard, tapioca pudding, rice pudding and similar dishes also may be permitted. In short, the food at this time must not only be purin-free and low in protein, but it should be extremely simple, easily digested and small in amount. Large quantities of water should be given.

In *chronic gout* the diet should possess the following characteristics: 1. In total caloric value it should be slightly below the calculated normal, say, 10 or 15 per cent minus. 2. It should be absolutely purin-free. 3. It should be low in protein. 4. It should be long continued.

Since it has been demonstrated that, independently of the nature of food, uric acid metabolism is increased by a high caloric intake, it is evident that the patient's total food intake should be held down to a low maintenance figure. Such a diet, as has been abundantly shown in diabetes, results also in a lowering of total metabolism, which is very much to be desired in gout. A diet which in caloric value is even as much as 20 per cent below the calculated normal is not only safe for the sufferer from gout, but in the long run will also tend to lessen the frequency and severity of his attacks. If it causes the obese patient to lose weight, so much the better; if it produces too much loss in the patient who is already thin, the food should be increased a bit. It is desirable in this disease to maintain the body weight at a figure which is about 10 or 15 per cent below normal.

It is essential that as far as possible the diet be purin-free. A few writers in the past have insisted that it is best to permit the patient a little purin-containing food which may be used as a source of building stones for his own tissues, but this argument loses its point today, since it is now known that the animal can synthesize his own nucleoproteins, and that therefore man's processes of tissue repair will not suffer even though he receive no purins in his food. It should be added, too, that from a practical standpoint it is almost impossible to secure a diet which is totally purin-free, for even the so-called "purin-free" foods have small traces of nucleoprotein.

The patient should eat no meat, broths or meat soups, and should particularly avoid cellular organs such as sweetbreads, liver and kidney. He should also avoid fowl and game. The statement that white meat is less harmful than dark meat has no basis in fact. The belief that fish, oysters and crustaceans are purin-free is also a mistake; they are in fact rich in purins, especially the smaller fish, such as sardines and anchovies. The benefits which came to the gouty from the restriction of meats was abundantly apparent in Germany during the World War. Müller[8] states that the enforced abstinence from meat during that period put a stop to the development of this disease, and brought marked amelioration of symptoms to those who already had gouty joints.

The protein allowance for the patient with chronic gout should be low, but care should be taken to give him enough. The condition here is somewhat similar to that in diabetes. We wish to avoid protein not only because through its specific dynamic action it stimulates metabolism, but also because it thereby increases the output of uric acid. On the other hand, a diet which is designed to be observed through months and years must supply sufficient protein, else the patient will suffer in vigor and perhaps even age prematurely (See Protein Problem, Chapter III). One gram of protein per kilogram of body weight is probably the minimal allowance. A little more, say 1.33 Gm. in the milder cases, is sometimes advisable. This protein should be chiefly in the form of milk, eggs, cheese, shad roe and other purin-free foods. In milder cases a little fish or meat may occasionally be permitted for variety's sake.

While many vegetables are practically purin-free, and can therefore be taken with impunity, there are others which are relatively rich in these bodies. Mushrooms, asparagus, cauliflower, spinach, lentils, beans and peas contain an appreciable amount of purins and therefore should be taken only in moderation. Vegetables are of definite value to the gouty patient, but he should never be given carte blanche in their selection. Fruits and cereals are practically purin-free, and therefore can be taken in quantity.

Carbohydrates in abundance in the form of fruits and purin-free vegetables should be permitted. Vegetables and fruits are practically all alkali-forming and their tendency is toward a lowering of the hydrogen ion concentration of the body fluids, and since monosodium urate is less soluble in an alkaline medium, such a diet may favor the deposition of uric acid in the tissues. To neutralize this tendency, hydrochloric acid, from 15 to 20 drops in water three times daily, may be given.

Fats, within the caloric limits of the diet, may be taken with impunity; cream and butter are valuable.

The diet should be plain and simple and should be such as will not lead to digestive disorders; rich, highly seasoned foods should be avoided and the meals should be taken at regular hours. The experience of many gouty patients has shown that violation of these rules may precipitate an attack.

Caffeine belongs in the purin group, and even though it is probably not convertible into uric acid, it should be avoided. It is best that the patient with gout should not drink tea or coffee, or at most one small cup of coffee for breakfast. Alcoholic beverages are harmful, but for those patients who are accustomed to take a little alcohol with their dinner and who persist in this practice, well diluted whisky is best.

It is possible that the purin-free diet accomplishes more than mere temporary benefit, for in purin metabolism many ferments are called into action, and a lessened demand for these may permit the ferment-producing organs to recuperate. Thus, it is conceivably possible by a properly adjusted long-continued diet so to improve the gouty patient's metabolism as to increase his tolerance for purins and thereby to relieve him to a certain extent at least of his disabilities. Proof of the value of such a restricted diet is cited by Brugsch[9] and also by Kraus[10] in the fact that during the war, German sufferers from gout, forced to live on low calorie, low protein, purin-free diet, were relieved almost entirely of their attacks.

Persistency is essential. Often after months of dietary restriction, when apparently nothing has been accomplished, patience is later rewarded by definite improvement. Sustained, long continued effort in dietary control should be insisted on.

Mineral waters are in themselves of little or no value; some of them, being alkaline, are distinctly harmful. The use in gout of the much advertised lithia waters is based on a misconception as to the nature of the disease; they are of no value. Some waters may be of theoretical value because of their radio-active properties. As a rule, however, any good table water, not alkaline, taken in sufficient quantities is suitable. Yeo[11] attributes the benefits to be derived by the gouty patient from mineral waters as follows:

(1) The quantity of water, more or less pure, taken into the body under regulated conditions daily.

(2) The altered mode of life, the regular exercise in the open air, the modified diet, the early hours, the absence of business cares.

(3) In many foreign spas there is the drier and hotter Continental climate.

(4) The stimulating effect to excretion and "tissue change" which the baths, douches, frictions, and manipulations applied at most of them induce."

Efforts have been made to determine the purin tolerance in gout as is done in diabetes, and to prescribe a diet just within this tolerance. This is not practical, and because the patient can be suitably nourished without purin-containing food it does not seem to be of advantage.

To what extent and when it is permissible to depart from the diet outlined above depends on the severity of the disease and on the patient's response to treatment. In the milder cases a little meat may be permitted from time to time, and in cases of moderate severity after six months or a year. The uric acid of the blood should be estimated from time to time, and the information thus obtained should in a measure serve as a guide in the construction of the diet.

Atophan (*cinchophen*) therapy is a great aid in the dietary regulation of gout. At the meeting of the medical section of the American Medical Association in June, 1913, I reported experiments showing that this drug, hastens excretion and that in the gouty patient it reduces the amount of uric acid in the blood. This was confirmed by subsequent observers.[12] Pratt summarizes its action as follows: "Atophan has then a four fold action. It increases the excretion, sets free stored uric acid, prevents further storage, and inhibits purin metabolism." It has been suggested that it, in its influence on the kidneys, is somewhat analogous to phloridzin. The drug had best be given in small doses, say 0.5 Gm., well diluted in water, four to six times daily. It may be continued over long periods of time or it may be given intermittently. When it seems advisable to increase temporarily the patient's diet, the simultaneous administration of atophan is always of benefit. For those patients who do not take atophan well, who are nauseated or who experience a ringing in the ear, novatophan (tolysin) may be given in the same dosage. The latter, however, is probably not as effective as the original preparation.

Atophan is especially useful in chronic gout, as it reduces the size of the tophi and lessens the frequency of the attacks. It will give pronounced relief when administered at the beginning of the acute attack, but Brugsch advises against its use during the height of the attack because of the already increased excretion of uric acid at that stage. Sufferers from acute gout should learn just when it should be taken.

TABLE 1.—*Purin Content of the Various Foods (J. Schmid and G. Bessau)**

100 Gm.	Bases N. in Grams	Uric Acid in Grams	100 Gm.	Bases N. in Grams	Uric Acid in Grams
Meat			Roquefort cheese	0	0
Beef	0.037	0.111	Cream cheese	0.005	0.015
Veal	0.038	0.114	Dairy cheese	0.022	0.066
Mutton	0.026	0.078	Vegetables		
Pork	0.041	0.123	Cucumber	0	0
Boiled ham	0.025	0.075	Lettuce	0.003	0.009
Smoked ham	0.024	0.072	Radish	0.005	0.015
Smoked salmon	0.017	0.051	Cauliflower	0.008	0.024
Smoked tongue	0.055	0.165	Garlic	Traces	Traces
Liver-wurst	0.038	0.114	Spinach	0.024	0.072
Blutwurst	0	0	Carrot	0	0
Brains	0.028	0.084	Green cabbage	0.002	0.006
Liver	0.093	0.279	Red cabbage	0.002	0.006
Kidney	0.080	0.240	Rape-cale	0.011	0.033
Sweet breads	0.330	0.990	Celery	0.005	0.015
Lungs	0.052	0.156	Asparagus	0.008	0.024
Chicken	0.029	0.087	Onions	0	0
Squab	0.058	0.174	String beans	0.002	0.006
Goose	0.033	0.099	White potatoes	0.002	0.006
Venison	0.039	0.117	Shell beans	0.027	0.081
Pheasant	0.034	0.102	Peas	0.018	0.054
Bouillon (100 Gm. beef)	0.015	0.045	Lentils	0.054	0.162
Fish			Beans	0.017	0.051
Shell fish	0.039	0.117	Mushrooms	0.018	0.054
Codfish	0.038	0.114	Fruit		
Eel (smoked)	0.027	0.081	Bananas	0	0
Salmon (fresh)	0.024	0.072	Pineapple	0	0
Carp	0.054	0.162	Peaches	0	0
Pike	0.045	0.135	Grapes	0	0
Pike	0.048	0.144	Tomatoes	0	0
Red herring	0.028	0.084	Pears	0	0
Herring	0.069	0.207	Plums	0	0
Trout	0.056	0.168	Whortle berries	0	0
Sprot	0.082	0.246	Oranges	0	0
Sardines	0.118	0.354	Apricots	0	0
Sardel	0.078	0.234	Blueberries	0	0
Anchovies	0.145	0.465	Apples	0	0
Crabs	0.020	0.060	Alomus	0	0
Oysters	0.029	0.087	Hazel nuts	0	0
Lobster	0.022	0.066	Walnuts	0	0
Eggs			Cereals		
Hen's eggs	0	0	Grits	0	0
Caviar	0	0	Barley	0	0
Shad roe	0	0	Rice	0	0
Milk and Cheese			Tapioca	0	0
Milk	0	0	Sago	0	0
Edam cheese	0	0	Oatmeal	0	0
Swiss cheese	0	0	Millet	0	0
Limburger cheese	0	0	Rolls	0	0
Tilsit cheese	0	0	Light bread	0	0

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* This table is taken from Brugsch, J.: Gicht, in Kraus and Brugsch: Specielle Pathologie und Therapie der innere Krankheiten, Berlin, 1913, p. 228.

Menus Suitable in Gout

	Protein	Calories
I.		
BREAKFAST:		
1 small baked apple with 4 tbsp. cream	2	
1 soft boiled egg	6	
1 whole wheat muffin or roll with 1 tsp. butter	4	
C. Kaffee Hag with 1 tsp. sugar and 1 tbsp. cream	1	
	13	601
DINNER:		
Potato au gratin	12	
3 tbsp. cabbage, creamed, 3 tbsp. creamed sauce	3	
2 h. tbsp. new string beans	1	
Beet and egg salad with 1 tsp. mayonnaise		
1 h. tbsp. beets and 1 egg	7	
1 muffin, 1 large slice bread	4	
3 h. tbsp. tapioca pudding	6	
1 glass milk	7	
	40	939
SUPPER:		
Toast a la golden rod, 1 slice bread toast, 3 tbsp. cream sauce and 1 grated hard boiled egg or 1 poached on toast	11	
2 h. tbsp. squash	1	
1 m. sliced tomato and lettuce	2	
Salad with cheese dressing; 1 tsp. cheese and 1 tsp. mayonnaise	3	
1 average sized slice bread	3	
2 heaping tbsp. snow pudding	5	
1 glass milk	7	
	32	757
Total	85	2,297

	Protein	Calories
II.		
BREAKFAST:		
1 peach or 2 sl. pineapple		
2 h. tbsp. farina with	2	
2 h. tsp. sugar and 5 tbsp. cream	3	
1 small roll or sl. bread with 1 tsp. butter and ½ tbsp. jelly	3	
1 cup Kaffee Hag with 2 tsp. sugar and 1 tbsp. cream	1	
	9	714
DINNER:		
Macaroni with cheese; 2 h. tbsp	19	
4 tbsp. red or white cabbage	1	
A. s. boiled onion, buttered	1	
A. s. tomato salad with lemon juice	2	
2 muffins	6	
2 h. tbsp. snow pudding	5	
1 glass milk	7	
	41	862
SUPPER:		
2 eggs, escalloped with 1 tsp. butter, ¼ gl. milk and 1 Uneeda biscuit	15	
3 h. tbsp. creamed celery	2	
3 h. tbsp. carrots with ½ tbsp. butter	1	
1 average slice bread	3	
Potato salad (1 small potato with 1 tsp. mayonnaise, a bit of egg and pickle)	2	
Fruit cup (1 a. s. orange and ½ gr. fruit)		
1 glass milk	7	769
	30	
Total	80	2,345

	Protein	Calories
III.		
Breakfast:		
1 a. s. orange	2	
1 slice cream toast	5	
1 shirred egg	6	
1 cup Kaffee Hag with 2 tsp. sugar and 2 tbsp. cream	2	
1 m. tomato sliced	2	
	17	579
Dinner:		
1 baked potato	4	
Cauliflower en casserole	6	
2 h. tbsp. squash	1	
Banana salad with 1 walnut	2	
Sprinkled on and 1 tsp. mayonnaise		
Served with about ½ full cream cheese or pineapple cheese	6	
2 sl. bread; 1 tsp. butter	6	
2 h. tbsp. snow pudding	5	
1 Glass milk	7	
	37	1,011
Supper:		
Cheese, cream	15	
Baked, stuffed (with vegetables) tomato	2	
3 tbsp. carrots; ½ tsp. butter	1	
Apple and celery salad on lettuce; ½ m. apple and 3 small stalks celery and 1 tsp. mayonnaise	3	
Rice custard with 2 tbsp. whipped cream	6	
1 Glass milk	7	
	34	771
Total	88	2,361

	Protein	Calories
IV.		
BREAKFAST:		
½ large grapefruit	2	
3 h. tbsp. force on cornflakes and 2 tsp. sugar and ⅓ gl. milk	3	
1 soft boiled egg	6	
1 a. s. slice toast with 1 tsp. butter and 1 tbsp. orange marmalade	2	
Cup Kaffee Hag with 2 tsp. sugar and 1 tbsp. cream	1	
	14	696
DINNER:		
Potato au gratin	12	
3 h. tbsp. creamed celery	2	
4 h. tbsp. new string beans	1	
Vegetable a. s. salad (cucumber, radish, onion on lettuce) with 1 dessert spoon French dressing	1	
2 a. s. corn or whole wheat muffin	6	
2 h. tbsp. rice pudding; 1 glass milk	13	
	35	985
SUPPER:		
2 egg omelet	12	
2 h. tbsp. hominy grits	2	
A. h. buttered onion	1	
Lettuce salad with cheese dressing (1 tsp. cheese in 1 tsp. mayonnaise)	3	
1 a. s. whole wheat bread	4	
2 h. tbsp. snow pudding	4	
1 gl. milk	7	
	33	706
Total	81	2,387

	Protein	Calories
V.		
BREAKFAST:		
1 m. s. orange	2	
1 shredded wheat biscuit or 1 h. tbsp. rice with 2 tsp. sugar	3	
and ½ gl. milk	4	
1 a. s. slice bread, toasted; 1 tsp. butter and ½ tbsp. preserves	3	
Kaffee Hag, 1 cup with 2 tsp. sugar and 2 tbsp. cream	2	
	14	725
DINNER:		
1 small baked potato	2	
Large baked stuffed tomato with 1 h. tbsp. rice and 1 tbsp. cheese	11	
Boiled cabbage, 3 heaping tbsp	1	
Egg salad on lettuce with 1 tsp. mayonnaise	6	
1 average sized slice bread	3	
3 h. tbsp. tapioca pudding	6	
1 gl. milk	7	
	36	903
SUPPER:		
Cheese, cream	15	
1 h. tbsp. spaghetti with tomato	2	
2 h. tbsp. new string beans	1	
A. s. lettuce salad with vinegar		
1 a. s. bread	3	
2 h. tbsp. soft custard	2	
1 gl. milk	7	
	30	760
Total	80	2,388

	Protein	Calories
VI.		
BREAKFAST:		
1 small orange	1	
2 h. tbsp. oatmeal with	3	
2 tsp. sugar and 4 tbsp. cream	3	
1 whole wheat muffin with ½ tsp. butter and 1 c. Kaffee Hag and 2 tsp. sugar with	4	
1 tbsp. cream	1	
	12	680
DINNER:		
2 h. tbsp. macaroni and cheese	19	
3 h. tbsp. boiled or steamed cabbage	1	
Stuffed tomato salad with 1 tsp. mayonnaise	2	
1 corn muffin or whole wheat bread	3	
2 h. tbsp. rice custard	6	
1 glass milk	7	
	38	976
SUPPER:		
2 soft boiled eggs	12	
5 stalks buttered asparagus; ½ tsp. butter	2	
3 small stalks celery stuffed with cheese, 1 tbsp. cream, 1 tbsp. cheese, and season	8	
1 baked banana with 1 tsp. sugar and 1 tsp. lemon juice	1	
1 a. s. sliced bread	3	
1 glass milk	7	
	33	781
Total	83	2,437

VII

	Protein	Calories
Breakfast:		
1 small orange	1	
4 h. tsp. oatmeal with	6	
2 tsp. sugar and 4 tbsp. cream	3	
1 a. s. sliced toast with 1 tsp. butter	2	
C. Kaffee Hag with 2 tsp. sugar and 2 tbsp. cream	1	
	12	760
Dinner:		
2 shirred eggs	12	
1 m. baked potato	4	
Cauliflower en casserole	6	
A. s. tomato salad with vinegar	2	
2 a. s. slices baker's bread	6	
1 h. tbsp. tapioca pudding	4	
1 gl. milk	7	
	41	930
Supper:		
Cheese, cream	15	
2 h. tbsp. buttered carrots	1	
Creamed cabbage	1	
(3 h. tbsp. cabbage and 3 tbsp. cream sauce)	2	
Medium serving lettuce salad with vinegar	1	
1 slice bread or muffin	3	
2 tbsp. soft custard	2	
1 gl. milk	7	
	32	793
Total	85	2,483

Purin-free Recipes

	Protein	Calories
CAULIFLOWER EN CASSEROLE:		
2 h. tbsp. boiled cauliflower		
1 tsp. butter		
1 tsp. cheese		
1 tsp. cracker		
Juice of cauliflower		
Put in individual casserole; season and sprinkle with cheese and crumbs.		
Contains	5	155
CHEESE, DREAM:		
1 oz. cheese (Amer. preferred)		
2 medium slices bread		
2 tsp. butter		
Butter bread, slice cheese, put between bread and toast in oven, both sides; contains	15	365
POTATO AU GRATIN:		
1 medium size potato, boiled		
2 tsp. dry grated cheese		
¼ gl. milk		
Bake in individual dish, each containing	12	261
TAPIOCA PUDDING:		
2 cups milk		
1 egg		
3 tbsp. tapioca, min.		
2 tbsp. sugar		
RICE CUSTARD:		
1 cup boiled rice		
2 eggs		
1½ cup milk		
2 h. tbsp. contains		
2 h. tbsp. contains	6	179
SOFT CUSTARD:		
1 egg yolk		
½ c. milk		
1 h. tbsp. sugar		
4 tbsp. contains	4	131
SNOW PUDDING:		
¾ cup water		
1 heaping tsp. gelatin		
1 tsp. lemon juice		
Lemon rind		
White of 1 egg		
2 h. tbsp. contains	5	67

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CHAPTER XIV

OBESITY AND LEANNESS

OBESITY

CLASSIFICATION OF OBESITY

Obesity is a condition of the body in which the weight, because of the excessive storage of fat, is above normal. Tables of normal weight will be found at the end of this book, but as such tables express simply the average for a given age, sex, height and weight, they should be accepted merely as a guide and should be readjusted to meet individual differences in body structure and conditions of life. The exact point at which obesity begins is hard to define, but as a general rule it can be said that a figure which is from 10 to 15 per cent above the fixed standard can be regarded as normal, while one that is 25 per cent or more above this standard represents obesity. There are between these figures, however, grades of overweight which under some circumstances can be regarded as normal and under others as abnormal. For instance, in heart disease, nephritis or gout, a body weight which exceeds the normal by as much as 10 per cent is excessive and therefore constitutes obesity. Such states of "relative obesity" demand attention.

The classification of obesity is difficult, because there is no satisfactory basis from which to proceed. From a clinical standpoint, the oft quoted grouping of fat people by Ebstein is not bad; those who inspire envy, those who occasion laughter and those who call forth sympathy. I hasten to add, however, that in America today the fashions are such that the first group does not exist; we begin with the second. The best basis for the classification of obesity is its pathogenesis, but because of the paucity of our knowledge of its pathology, even this grouping must be regarded as merely tentative. From this standpoint, we can recognize three types: (1) alimentary obesity, (2) constitutional obesity and (3) the obesity which appears as an accompaniment of other diseases (thyroid, pituitary).

Alimentary Obesity.—The person with *alimentary obesity* eats too much, exercises too little, or both; his food intake is absolutely or relatively excessive. He may take an amount of food which under ordinary circumstances would be regarded as appropriate, but if he is lazy, sleeps too much, and takes little or no exercise, then this amount becomes excessive. In the majority of instances, both causes are operative—too much food and too little activity. Even a familial tendency toward obesity may at times be appropriately included here, for a combination of such inherited and environmental factors as good appetite, good digestion, a phlegmatic temperament, liberal housekeeping and faulty dietary customs will surely lead to obesity. Even a very small dietary overload may in time produce obesity. A food intake which is only slightly in excess of the body needs, if continued through months and years by a person with a tendency toward obesity, will occasion the deposition of considerable fat. Only a few grams surplus food each day—a good helping of butter or a liberal serving of cream—can in the course of a year add 2 or 3 pounds to the body weight; in ten years, 20 or 30 pounds. If such a person takes daily only 200 or 300 calories in excess of his needs in the course of a year he will probably add 8 or 10 pounds to his body weight; let him continue this through a number of years, and he will surely become obese.

On the other hand, it is interesting that some people, without giving particular thought to what they eat or how they live, maintain throughout a long period of years a fixed body weight. These people from year to year vary hardly a pound in weight. There evidently is in the normal man some regulatory mechanism which balances appetite and desire for physical exertion. Unconsciously, such a man when he eats too much feels the need for a little more exercise, and he takes it; or if his activities are restricted, his desire for food is lessened. Is it not possible that obesity at times expresses a failure of this regulatory mechanism to synchronize properly?

Age is of influence, for as the normal person grows older, he puts on a little more fat; at 30 years he is as a rule about 10 pounds heavier than at 20, and again at 40 or 45 another 10 or 12 pounds has been added. This is of such frequent occurrence that it can be regarded as physiologic. This tendency may be an accompaniment merely of the contentment and mental relaxation which comes with middle age; or it may come from diminished exercise, from lessened activity of the thyroid or other endocrine organs, or from a slowing down for unknown reason of general metabolic activity.

Constitutional Obesity.—This is the second type, and probably represents a disease in itself, or rather, an anomaly of metabolism which is ill defined but clearly recognizable. It holds for the student of nutrition many interesting problems. Some excessively obese people retain their great body weight on a caloric intake which is far below the calculated normal. Strouse and Dye,[1] in commenting on the obese patients studied by them, write: "Persons showing this predisposition show no interdependence between food intake, energy expense and fat. The data thus accumulated prove that certain types of obese persons maintain their weight without regard to the usually accepted caloric balance." In a subsequent paper, Strouse and his associates[2] conclude that this cannot be explained by a lowering of basal metabolism, for they find that neither excessive underweight nor excessive overweight is associated with any constant change in basal metabolism, from which the conclusion is drawn that there is some abnormality of the mechanism by which the obese person deals with the materials brought to him for metabolism. This is borne out by the later studies of the respiratory quotients of obese people by Wang and Strouse,[16] which indicate that such subjects burn fat less readily than normal people. Similar studies by Hagedorn and his associates[17] "confirm the belief that obesity is due to a qualitative anomaly in metabolism i.e., an abnormally increased transformation of carbohydrate into fat." Whatever the explanation, it is clear that on almost any reasonable caloric intake, no matter how small, such a patient will store fat.

Brugsch,[3] in support of the theory of a distinct lipogenous tendency, cites two facts: first, low metabolic rates are not limited entirely to obese patients, and therefore cannot be regarded as the sole cause of constitutional obesity; second, abnormal depositions of fat such as occur in circumscribed lipomas, in adiposis dolorosa and in dystrophia adiposo-genitalis, are wholly uncontrolled by dietary regulation and are almost entirely beyond the influence of ordinary metabolic processes; it is not improbable that in constitutional obesity there is a disturbance of similar nature. This is in agreement with Strouse and his associates,[4] not only in the conclusions above quoted, but in their studies of the specific dynamic action of food, wherein the interesting observation was made that the obese patient does not obtain from his foodstuffs the same specific dynamic action as the normal person. After studies on twelve subjects, they conclude that protein does not produce in obesity the specific dynamic action seen in health, or at best to only a slight extent. They observed also that there was a lessening of the specific dynamic action of carbohydrate but not to such a marked degree as with protein. The assumption seems warranted therefore that constitutional obesity expresses a distinct anomaly of energy exchange which results in a tendency toward fat accumulation, and that limitation of total metabolic activity is merely a secondary feature of this anomaly.

Obesity in Various Disease Conditions.—The third group comprises a heterogeneous list of diseases a common feature of which is a disturbance of metabolism leading to the abnormal deposition of fat. This could perhaps with propriety be called the endocrine group, because the obesity of so many of these patients seems to be caused by disturbance of the organs of internal secretion; but the difficulty here is that we are sometimes in doubt not only as to just what organs are diseased, but also as to whether the underlying disturbance after all is in the organs of internal secretion. In many instances, however, there is distinct evidence, both clinical and anatomic, of disease of the endocrine organs.

In this group should be included the following: (1) adiposis dolorosa or Dercum's disease, in which adiposity, circumscribed or diffuse, asthenia, pains and psychic disturbances are prominent; the assumption is that this disease with its many borderline types rests on a disturbance of the glands of internal secretion, perhaps of the pituitary or thyroid gland. (2) Dystrophia adiposo-genitalis, a syndrome described by Fröhlich and believed to result from disease of the pituitary gland, in which there is overgrowth of the skeleton, obesity and dysgenitalism. (3) Thyroid obesity, which results from thyroid deficiency, and which usually, though not invariably, begins in early life and is to be distinguished from myxedema; as a rule, the basal metabolism is low, and although mild degrees are occasionally seen in which the metabolic rate is normal, all patients are benefited by thyroid therapy. (4) Obesity of genital origin, related to disease or developmental defects of the gonads and exhibiting as a rule abnormal distribution of fat; examples of this are the obese children whose gonads have not properly developed, eunuchs and women who have had their ovaries removed. (5) Obesity which is associated with disease of the pineal and suprarenal glands. (6) Other abnormal deposits of fat, circumscribed or diffuse, to which the term lipomatosis is applied. The diseases included in this group require little consideration here, because in their treatment diet is of little or no avail.

PROPHYLAXIS OF OBESITY

To strive to remain thin is particularly encumbent on three groups of people: (1) those who are handicapped by a family tendency to obesity; (2) those who have a diabetic tendency or whose family history tells of diabetes, and (3) chronic sufferers from heart disease, nephritis, arthritis or gout. Each of these, if he would enjoy life to the fullest extent and experience normal expectancy, must remain thin.

Prevention of obesity demands the same type of dietary regimen, though not so rigid as is advised for its cure. A person's dietary habits are usually determined by custom, in which is included the habits of his family and of others with whom he associates, with the result that he chooses his food with little consideration other than habit and the sense of satisfaction which it gives him; he thus becomes guilty of dietary faults which are common to those around him. If on inquiry it is found that the food is too rich and that too much is eaten, or that excessive amounts of sweets and other carbohydrates are taken, correction should be easy.

If the person with a tendency toward obesity would remain thin, he should content himself with simply prepared foods which are not rich in fats, and should permit in his diet little butter and little or no cream. He should eat comparatively little bread and should prefer potatoes because of their greater satiety value. At first, untiring vigilance and rigid self denial is necessary, but as a rule there finally comes a time when continued temperance in diet leads to such a change in habit and improvement in taste as will enable the patient to get along happily on the properly restricted intake. There is no advantage in "freak diets." It is a mistake to omit breakfast just in order to eat a large lunch, or to confine oneself largely to such bizarre articles as pickles and lettuce. Three meals daily, restricted in amount and simply planned with due regard for the ordinary laws of nutrition, should be the rule.

INDICATIONS FOR A REDUCTION CURE

Today when it is stylish to be thin there are many insistent demands, particularly from women, for advice as to reduction of weight. Many of these in their effort to become stylishly thin have done themselves real harm, for they have starved to the point of extreme underweight and have brought on weakness, nervous instability, anemia and other penalties of under-nutrition. This type of reduction should be discouraged.

In addition, there are a few genuinely obese people whose weight should be reduced with great caution, if at all. In chronic advanced illness, as in myocardial failure and nephritis, the reduction of obesity, while desirable, should be slow and should be carried out with care, during which process the patient should remain the greater part of the day in bed. This applies also to elderly people and particularly to those who have for a long time been overweight, for these patients, being unable to stand well any sudden or drastic curtailment of their food, are likely under such treatment to appear suddenly older or to exhibit distressing, even alarming, weakness and perhaps myocardial failure. Obese children are often sufferers from some endocrine disturbance and are therefore to be benefited but little by diet. Food curtailment in the child is practically always a mistake; for it is likely to retard development.

There are, on the other hand, manifold reasons why obesity in the average person should be corrected: 1. People who remain thin as they grow older are less likely to have disease, and therefore live longer, a fact which is attested by life insurance actuaries in their statement that such people are better risks. Joslin emphasizes time and again the fact that diabetes is one of the penalties of obesity; 2. Too much fat interferes materially with physical activity. The fat man cannot exercise comfortably because he always carries with him an extra load, because the accumulation of fat in and around his muscles interferes with their easy contractility, and because his great body weight tends to produce flat feet. Lack of exercise leads to more fat, and there is thus established a vicious circle. 3. Obesity handicaps the heart because increased body weight adds to the work demanded of it, while the deposition of fat in and around this organ actually lessens to a considerable degree its capacity to meet these demands. 4. The deposition of fat in the abdominal cavity limits materially the freedom of movement of the diaphragm and of the other organs. 5. The function of the skin to regulate heat loss and to maintain body temperature is seriously impaired by extensive deposits of fat, because fat is a poor conductor of heat, and with its poor blood supply it impedes the circulation of blood in the skin. Thus it is seen that the influences enumerated above combine to place a great handicap on the person with an excess of fat. It is to relieve this handicap chiefly, and secondarily for the sake of appearance, that obesity cures should be undertaken.

The necessity for reduction applies particularly to people who are 20, 30 and 40 per cent or more overweight, and only under exceptional circumstances to those who are slightly, say 10 or 15 per cent, above the ideal. This exception includes patients who have heart disease or who show a tendency, latent or manifest, to such metabolic disorders as diabetes or gout, for such people should strive to remain always a few pounds underweight.

TREATMENT OF OBESITY

The objects of the treatment of obesity are twofold: (1) to curtail the intake of food, and (2) to increase its utilization. In restricting the intake, precautions should be taken to avoid: (*a*) loss of body protein, (*b*) mineral or vitamin deficiency, and (*c*) the distress of great hunger. The curtailment of food should be accomplished along rational lines and according to known physiologic laws, for if this is done the cure will be more effective and harm will be avoided. Reduction cures can be roughly divided into two types: the mild and the intensive. The former type is infinitely better and, except under unusual circumstances, should always be used. It will be described first.

To accomplish a satisfactory reduction in weight and at the same time permit the patient to retain unimpaired his strength, looks and sense of well-being, the loss should be gradual, at the rate, say, of from 2 to 5 pounds monthly. This is ample and should seldom be exceeded; at times the temptation is great to both the physician and the patient to bring about a rapid, graphic loss in weight, but to do this is a mistake. A small gradual loss should continue for four or five months, until 20 or 25 pounds have been taken from the weight, at which point the diet should be increased to a maintenance figure (but no more), and the patient should be permitted to hold his weight for a few months. After this, a similar reduction, if need be, may again be instituted until another loss of the same amount has been induced or until the requisite weight has been attained. This stepwise reduction in unusually obese people or in people who have for a long time been overweight obviates many of the disagreeable effects which sometimes accompany reduction cures. Whether the final attempt should be to bring the patient completely down to his calculated ideal, or to permit him to remain slightly overweight, say 10 pounds or more, depends on the circumstances, among other things on the previous grade of his obesity and the length of time he has been a sufferer.

The patient should weigh himself weekly, not oftener, for daily weighing occasions too many disappointments. It should always by at the same time of day, preferably just before the mid-day meal and with the same weight of clothing.

Caloric Intake.—The caloric intake is the first thing to be considered in the reduction diet. It should be about 20 to 35 per cent below the calculated maintenance diet—calculated not for the patient's actual but for his ideal weight. Tables of normal weight are given at the end of the book but for the present purposes the following rule is sufficiently accurate: The ideal weight expressed in kilograms should equal the number of centimeters by which the total height exceeds 1 meter; weight (kilograms) = height (cm.) − 100. Thus a man who is 176 cm. tall, should weigh approximately 76 kilograms (176 minus 100). Tables of caloric requirement given in Chapter III may be used in these computations, but we can say roughly that the person who is up and about but who is doing no hard work will require for maintenance not far from 35 calories per kilogram of body weight; to induce loss in weight he should take a diet which is from 20 to 25 per cent below this figure, or one which provides from 20 to 25 calories per kilogram of ideal body weight. Thus, for a patient whose ideal weight is 70 kilograms (no matter what the actual weight) the appropriate reduction diet should provide from 1,400 to 1,700 calories. A somewhat more rigid restriction is sometimes advisable, say to 17 or 18 calories per kilogram, or for this patient a total of from 1,100 to 1,250 calories. (See tables, pages 414 to 417.)

The **preservation of nitrogen equilibrium** should be the next consideration in the arrangement of this diet.* This is of paramount importance. The object here should be to force the patient to burn his own fat, and this without loss of body protein. This is not difficult to accomplish, for nitrogen equilibrium and carbon balance do not necessarily go hand in hand: the one can be preserved without the other. Lusk[5] has demonstrated that an animal, while conserving body protein, can be made to lose weight at the expense of body fat, provided the diet contains sufficient protein and is of low caloric value. Therefore, the first dietary principle of the treatment should be a menu which in caloric value is materially below the patient's needs, and yet which has a protein content abundantly equal to these needs.

This liberal quota of protein is recommended chiefly for the preservation of nitrogen equilibrium, but also because the specific dynamic action of this foodstuff in some patients (though not in all) is an effective aid toward securing increased metabolic activity. From 1.5 to 1.7 Gm. of protein per kilogram of calculated ideal body weight can be regarded in the reduction cure as an appropriate amount. True, an excessive protein intake is harmful to the kidneys; but the amount recommended here, liberal though it is, cannot be called excessive. No harm, under ordinary circumstances, can come from protein taken in this amount.

In addition to the amount of protein permitted, some consideration should be given also to its biologic value. In order to throw the smallest burden on the kidney and to preserve nitrogen balance in the most economical manner, the patient should choose proteins of high biologic value. These are proteins which supply to the organism in full measure all the amino-acids necessary to the building of the animal's own tissues. Chief among them are the proteins of meat, eggs and milk.

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* The paragraphs which follow are in part taken from a paper on obesity which the author read before the medical section of the American Medical Association in June, 1924.

Carbohydrate Quota.—Turning to the carbohydrate quota of the diet, this foodstuff serves two important purposes. First, it is the chief source of energy for the maintenance of body temperature and, in overwhelming measure, for the production of work: and second, it is a most efficient protein sparer. To preserve nitrogen balance at an economical level, it has been shown that at least 50 per cent of the energy contained in the food should come from carbohydrate. Fat will not serve the same purpose. It is clear, therefore, that the effort of many obese persons to avoid all starchy foods and to eschew all sweets is without reason. After computing the caloric value of the protein allowance, there should be added to the diet an amount of carbohydrate sufficient to bring its value almost or fully up to the desired total caloric intake.

The precaution should be taken to see that this carbohydrate portion of the diet includes sufficient of the vitamin-carrying foods, such as fruits, tomatoes and the leafy portion of green vegetables. The need for vitamins in the reduction cure is sometimes forgotten. Spinach, lettuce, cauliflower, cabbage and asparagus are valuable articles. The legumes, such as beans and peas, because of their greater caloric value, should be taken only in moderation.

Fats.—With fats, the circumstances are different. Aside from considerations of appetite, this foodstuff finds a prominent place in the usual meal because of its high caloric value. For the obese person, however, this consideration no longer holds good, and fat is not a necessary part of the diet. Fat is the one foodstuff that in obesity we can afford to reduce to a minimum or, still better, omit altogether.

Water.—The other food factor to be considered is water. It can be stated with assurance that obesity is not increased by the excessive drinking of water, and that it is not relieved by abstention from water. In fact, the reverse may be true, for Hawk[6] has shown that water, in some small measure, acts as a stimulus to metabolism, which leads one to conclude that the liberal drinking of water is to be recommended. There is, however, one objection: the excessive drinking of water often induces the patient to eat more food. If this error is guarded against, an abundance of water should be advised. Mineral waters, except when their laxative properties are desired, are of no especial value.

The benefits obtained at the famous European spas can be attributed to hygienic and dietary regulation rather than to any specific properties of the water.

Satiety Values.—There is yet another aspect of the diet which is seldom considered, but which is of extreme importance. It is the extent to which the food gives a sense of well-being and satisfaction, its satiety value, so called. Other things being equal, the patient should be allowed to eat the food which in largest measure allays his hunger and which gives him the greatest degree of satisfaction. Meat has the highest satiety value of all foods; it "sticks to the ribs" longest. Therefore, the protein that the patient receives should be largely in the form of meat. For the same reason, clear meat soups and broths are also useful; they have high satiety values without carrying much real nourishment.* Since hard boiled eggs have a higher satiety value than soft boiled eggs, although the two are obviously of equal caloric value, the former should be preferred. Likewise, potatoes are preferable to bread, because in isodynamic quantities the former have a higher satiety value.

In this connection is seen the importance of sweets. A dessert taken at the end of the meal, as has been shown by Kestner,[7] will enhance greatly its satiety value. Not only are simple sweets, when credited with their proper caloric value, of no harm, but when taken at the proper time they will permit the patient to rest satisfied with a smaller quantity of food. If we would hold the patient down to a minimal intake and at the same time satisfy him, we should add always to the heavy meal a little dessert.

Short fasts are sometimes advisable. What are their influence on the metabolism of obesity? Starvation, even in the most obese, necessarily causes some loss of body protein, but what we fear most is that the abnormal destruction at this time of excessive amounts of fat may produce a surplus of fatty acids and lead to the condition known as acidosis. Abderhalden and Lampé[8] have shown, however, that repeated short fasts increase progressively the ability of the dog to split fatty acids, and Folin and Denis[9] have observed something similar in man. The last named investigators offer the assurance that repeated fasting in the obese is safe and effective, provided the extent of the acidosis is carefully watched. Many German clinicians advise a fast day once each week. It may be absolute or partial. In the former the patient is given only clear bouillon, water, coffee and perhaps a few Graham crackers; in the latter, fruits in small amounts such as apples or oranges are added.

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* It is obvious that it is not intended to include here thick soups made from carbohydrate foods or those which are rich in fats.

Stimulation of Metabolism.—Leaving the question of food restriction and turning to the second therapeutic factor, the stimulation of metabolism, there are two effective physical means for accomplishing this end. First and foremost comes exercise. Exercise hastens materially the metabolic rate and leads to the increased oxidation of ingested food, or, if food is not available, then of body fat. The exercise should be of the right sort and should never be carried to the point of exhaustion. It should be mild and long continued rather than violent. It should be regular, not spasmodic, and if possible the patient should find in it interest and diversion. Exercise is the chief factor on which we must depend first and always for the stimulation of metabolism and for the oxidation of surplus fat.

The other useful physical stimulus is the cold bath. A cold shower or plunge greatly increases the metabolic rate, which increase persists for a long time afterward.[10] Because its value is not fully appreciated and because the life of ease to which the fat person is often accustomed does not prepare him for the momentary punishment entailed in the cold bath, this procedure has been neglected. It has been said that patients who are more than 45 years of age do not stand this well; but if the heart is intact, the arteries not too sclerotic, and the blood pressure not too high, I doubt whether the cold bath does as much harm as continued obesity. An exception should be made, perhaps, of those people who genuinely do not react, and who feel chilly for several hours after the bath; but for the obese patient who reacts promptly, however disagreeable the shock, the cold morning bath is to be recommended.

Walking is the best form of exercise; golf is excellent. Calesthenic exercises to be carried out in the bedroom in the morning are all right but they are a nuisance after the novelty wears off, and few patients continue them long. Gymnasium exercise becomes monotonous and often is too strenuous. Swimming is good. Horseback riding is fairly good exercise, but it is usually the horse rather than the rider who loses weight. After all, an hour's walk in the morning and again in the afternoon, or when it is possible, eighteen holes of golf twice weekly is the most satisfactory means of stimulating metabolism.

Caution should be observed always in advising exercise for patients with heart disease, marked atherosclerosis or similar physical handicaps; for the amount and kind of exercise should always be adjusted to the patient's capabilities.

Intensive Cures.—Intensive reduction cures should be undertaken only when milder forms of treatment have failed or when for good reason the rapid removal of fat is advisable. These cures are sometimes desired by patients who have not the moral stamina and stability of purpose to endure long continued dietary deprivation, which explains why intensive cures often are not permanent and why there is too often an eventual return to the old faulty habits of diet. The objection to this more drastic method of procedure is that rapid loss of weight frequently impairs the heart, produces anemia and leaves the patient weak, haggard, wrinkled and old in appearance. When the intensive reduction cure is preferred, it should be instituted in a hospital or sanitarium, and the patient should be kept in bed for the first one or two weeks. Care should be taken when he gets up to warn him against a return to his old dietary habits. The duration of such a cure should be short, say two or three weeks, after which a somewhat more liberal diet should be permitted. This type of regimen usually permits a total caloric intake which is 50 or 60 per cent below the maintenance diet appropriate for the calculated ideal weight.

Thyroid Medication.—Desiccated thyroid substance may cautiously be used as an aid to diet in certain types of obesity. This is particularly suitable in patients who are overweight because of myxedema, borderline or outspoken, and obese people with an abnormally low basal metabolism. A few middle-aged poeple whose slow pulse rate, low pulse pressure, sluggishness, dry skin and other symptoms, in spite of an apparently normal basal metabolism, suggest obesity of thyroid origin, are also benefited by thyroid therapy. Patients of this last group should be given thyroid substance only tentatively, and it should be immediately withdrawn when the least untoward symptoms are produced. It should be given at first in very small doses, say one-half grain twice daily; this daily dose may then be increased to 1½ grains and finally after two weeks or more to 2½ grains. For long continued administration 1 to 2 grains daily is, as a rule, ample, for when more seems necessary it has probably failed of absorption. The metabolic rate does not immediately adjust itself to changes in the dosage of the drug; therefore sufficient time to obtain results must be observed before changes are made. In true myxedema, Plummer and Boothby[11] give at the outset one very large dose of desiccated thyroid (from 2 to 4 Gm.), but for the obese patients under consideration, the method above described seems more suitable. Repeated estimations of basal metabolism should be made while thyroid therapy is in effect; if the means for making such estimations are not available, the physician must be guided by the pulse rate, and the appearance of headache, nervousness, nausea and other toxic effects. He should be thoroughly familiar with the clinical effects of thyroid substance and should keep his patient under close observation. Thyroid substance, even in the cases under consideration, should never be used as the principal therapeutic agent; dietary restriction should always come first.

REDUCTION DIETS

The following diets have been found useful by the author. The first group of menus (one week) is designed for the slower and the second group for the more rapid (intensive) reduction; the third group constitutes the lactovegetarian regimen and is intended for the milder cures.

THE MILD REDUCTION DIET*

Sunday

	Protein	Calories
Breakfast:		
½ large grape fruit		
Scalloped cod fish (or canned fish flakes)		
2 heaping tbsp. stewed tomatoes		
Average helping saltine crackers	25	
Coffee, 1 tsp. sugar		
1 tsp. butter		
	25	374
Dinner:		
Large serving 2 slices roast beef, very lean with tomato or mushroom sauce	46	
Medium sized baked potato	4	
2 h. tbsp. beet greens or spinach, a. h.	2	
2 h. tbsp. pickled beets and 8 slices cucumber	2	
Fruit cup (1 medium orange and ½ grape fruit; a few grapes; no sugar)		
1 glass butter milk	6	
1 tsp. butter		
	60	654
Supper:		
1 slice cold roast lamb with mint sauce	15	
and 1 tbsp. green peas	2	
2 h. tbsp. squash	1	
3 h. tbsp. mustard greens or cabbage		
M. s. tomato salad with vinegar or mineral oil dressing	2	
2 Uneeda biscuits	1	
½ m. cantaloupe or 8 h. tbsp. strawberries		
1 glass skim milk	7	
	28	524
Total	113	1,532

* Cook all vegetables without fat.

MONDAY

	Protein	Calories
BREAKFAST:		
1 m. s. orange		
1 a. h. sweet breads or brains	32	
broiled or scrambled with 1 egg	6	
1 a. s. slice toast	2	
1 tsp. butter		
Cup coffee or tea with 1 tsp. sugar		
	40	397
DINNER:		
Large helping, 2 slices roast lamb or fish	28	
2 tbsp. mashed potatoes	3	
2 h. tbsp. string beans		
3 h. tbsp. greens	2	
Egg salad with mineral oil dressing	6	
2 slices pineapple		
1 tsp. butter for cooking		
1 glass butter milk	7	
	46	725
SUPPER:		
6 panned oysters	5	
2 h. tbsp. spinach	2	
A. h. (5 stalks) asparagus	2	
A. h. lettuce salad with vinegar		
1 bran muffin	2	
Fruit cup (1 orange; ½ grapefruit)		
½ tbsp. butter for cooking		
1 glass skim milk	7	
	18	398
Total	104	1,520

TUESDAY

	Protein	Calories
BREAKFAST:		
2 slices fresh pineapple or canned without juice or a. s. peach		
A. h. broiled sweet breads with tomato sauce—1 tbsp. butter	32	
1 piece zwieback	1	
Coffee with 1 tsp. sugar		
	33	322
DINNER:		
Small serving roast chicken (white meat)	16	
2 h. tbsp. squash	1	
2 h. tbsp. spinach or beet greens	2	
Cauliflower en casserole	6	
French artichoke and lettuce served as salad with mineral oil mayonnaise	6	
Egg custard	9	
1 average slice whole wheat bread	4	
½ tbsp. butter for seasoning		
1 glass skim milk	7	
	51	802
SUPPER:		
2 scrambled eggs with	6	
2 h. tbsp. stewed tomatoes	7	
Buttered beets	1	
Spinach salad with lettuce with mineral oil mayonnaise	2	
1 bran muffin	2	
1 large orange sliced	1	
1 tsp. butter		
1 glass butter milk	6	
	26	478
Total	110	1,602

WEDNESDAY

	Protein	Calories
BREAKFAST:		
1 m. s. orange		
A. h. broiled fish with lemon	22	
Soft boiled egg	6	
1 a. s. slice toast—1 tsp. butter for cooking, etc	1	
Coffee or tea with 1 tsp. sugar		
	29	387
DINNER:		
A. h. round steak, made into patty	28	
1 m. s. baked potato	4	
A. h. beet greens or spinach	2	
A. h. boiled onion	1	
Average serving fresh vegetable salad with vinegar		
Fruit cup—1 orange, ½ grape fruit		
1 glass skim milk	7	
1 tsp. butter		
	42	666
SUPPER:		
1 lean mutton chop with 1 tbsp. peas	25	
4 h. tbsp. string beans, ½ tsp. butter	1	
2 Uneeda biscuits	1	
Spinach salad with 2 or 3 slices of tomato, on lettuce; serve with mineral oil mayonnaise	2	
1 glass butter milk	7	
Lemon Jello		
	36	466
Total	108	1,519

Thursday

	Protein	Calories
Breakfast:		
1 peach or average sized orange or ½ gr. fruit		
Average helping brains; scrambled with 1 egg	38	
1 small slice toast; ½ tsp. butter	1	
Cup coffee with 1 tsp. sugar		
	39	352
Dinner:		
A. h. roast beef very lean	23	
1 m. s. baked potato	2	
A. h. cauliflower		
A. s. tomato and lettuce salad with vinegar or mineral oil dressing	2	
2 h. tbsp. orange ice	1	
1 tsp. butter		
1 glass skim milk	7	
	35	692
Supper:		
10 panned oysters on hot plate	11	
A. h. string beans		
A. h. spinach or beet greens	2	
Egg and lettuce salad with mineral mayonnaise	6	
2 bran muffins	4	
Fruit cup—1 orange and ½ grapefruit		
Glass butter milk, 1 tsp. butter	7	
	30	498
Total	104	1,542

FRIDAY

	Protein	Calories
BREAKFAST:		
½ large grape fruit		
A. h. boiled fish with 1 hard boiled egg; 1 tsp. butter	27	
1 sl. zwieback	1	
1 cup coffee with 1 tsp. sugar		
	28	472
DINNER:		
A. h. roast chicken	32	
A. h. potatoes	4	
A. h. egg plant	1	
A. s. beet salad with vinegar		
Egg custard	9	
1 glass skimmed milk	7	
	53	571
SUPPER:		
3 slices cold tongue	15	
2 h. tbsp. stewed tomatoes		
3 tbsp. creamed celery	1	
3 Uneeda biscuits	2	
Spinach salad with ½ hard boiled egg	5	
Peach whip	4	
1 glass butter milk	6	
	33	514
Total	114	1,557

SATURDAY

	Protein	Calories
BREAKFAST:		
1 large orange		
2 egg omelet with	12	
6 panned oysters; ½ tsp. butter	6	
2 small bran muffins	4	
Cup coffee with 1 tsp. sugar		
	22	461
DINNER:		
¼ lb. round steak, lean-ground and made into meat patty; serve with tomato sauce	27	
2 h. tbsp. potatoes	3	
Boiled onion	2	
1 tsp. butter		
Spinach salad with ½ egg, mineral oil mayonnaise	5	
Fruit cup—1 orange and ½ grape fruit		
Tea or lemonade with 1 tsp. sugar		
	37	559
SUPPER:		
A. h. broiled sweet breads	32	
Asparagus (5 stalks) buttered	2	
2 h. tbsp. egg plant en casserole	3	
M. s. tomato salad with mineral oil mayonnaise		
2 Uneeda biscuits	4	
1 glass lemonade with 2 tsp. sugar and 1 Graham cracker; 1 tsp. butter	1	
	42	510
Total	101	1,630

INTENSIVE REDUCTION DIETS

Sunday

	Carbohydrate	Protein	Fat	Calories
Breakfast:				
1 m. s. orange	10			
A. h. broiled fish or meat; no fat	..	23		
1 a. s. slice hard toast	12	2		
1 tsp. butter	..	..	4	
Cup coffee or tea with saccharin				
	22	25	4	224
Dinner:				
1 large serving—2 slices lean roast beef with mushroom or tomato sauce	..	46	2	
A. h. string beans	5	1		
Spinach salad with ½ egg yolk hard boiled and obesity dressing	13	4	7	
Orange Jello, made with saccharine	4	3		
1 Graham cracker—1 tsp. butter	6	1	4	
Tea or lemonade with 1 tsp. sugar	10			
	38	55	13	489
Supper:				
1 h. tbsp. brains scrambled with 1 egg	..	22	6	
M. s. tomato, stuffed with celery, green pepper, onion, etc., and baked	8	2		
Buttered asparagus, 5 stalks	4	2		
Grapefruit salad, 1 m. s. grapefruit with obesity dressing	10			
½ glass butter milk—1 Uneeda biscuit	9	3	1	
½ tbsp. butter	..	..	6	
	31	27	13	377
Total	91	109	30	1,090

MONDAY

	Carbohydrate	Protein	Fat	Calories
BREAKFAST:				
½ grapefruit (large)	10			
Small helping broiled sweet breads with tomato	..	16		
sauce—1 soft boiled egg	..	6	6	
1 zwieback; ½ tsp. butter	11	1	3	
1 cup coffee or tea, with saccharin				
	21	23	9	257
DINNER:				
6 oysters on half shell	3	5	1	
1 average serving roast chicken, white meat	2	23	4	
2 h. tbsp. beet greens or spinach	3	2	4	
Large stuffed tomato salad with obesity mayonnaise	8	2		
2 Uneeda biscuits; 1 tsp. butter	10	2	5	
Orange ice	15	2	2	
Tea with 1 tsp. sugar	10			
	51	36	16	492
SUPPER:				
Large patty of lean scraped beef; no fat with mushroom or tomato sauce	..	21		
Egg plant en casserole	5	4	2	
Spinach salad with 2 or 3 slices of tomato for garnishing; lettuce leaf with obesity mayonnaise	3	2	4	
Peach whip	5	4		
2 Uneeda biscuits: 1 tsp. butter	10	2	4	
½ glass orange juice	12			
	35	33	10	362
Total	107	92	35	1,111

TUESDAY

	Carbohydrate	Protein	Fat	Calories
BREAKFAST:				
1 large peach or medium size orange	10			
2 lean lamb or mutton chops and	..	22	5	
1 shirred egg	..	6	5	
1 zwieback; ½ tsp. butter	11	1	3	
1 cup coffee or tea with saccharin				
	21	29	14	326
DINNER:				
Fruit cup (½ each orange and grape fruit)	10			
1 a. serving broiled fish with lemon	..	23	4	
Small baked potato	16	2		
Cauliflower en casserole	3	3	4	
Large slice tomato salad with obesity dressing or vinegar	8	2		
Baked custard	10	9	6	
Tea or lemonade with saccharine				
	47	39	14	479
SUPPER:				
12 panned oysters on hot plate	6	11	2	
Baked stuffed tomato	8	2	2	
A. h. greens	4	2		
Beet (2 tbsp.) and egg (½ hard boiled)				
Salad	3	4	3	
Spanish cream (orange)	12	6		
Tea with saccharin				
	33	25	7	295
Total	101	93	36	1,100

WEDNESDAY

	Carbohydrate	Protein	Fat	Calories
BREAKFAST:				
½ grapefruit large	10			
Average helping broiled sweet breads	..	32		
1 medium slice toast; 1 tsp. butter	12	2	4	
Cup coffee or tea	—	—	—	—
	22	34	4	260
DINNER:				
A. serving, 1 slice, roast lamb (no fat)	..	15	4	
2 tbsp. green peas	8	4		
2 h. tbsp. beet greens or spinach	3	2		
Large stuffed tomato salad	8	2		
Orange ice	15	2	2	
2 Uneeda biscuit; 1 tsp. butter	8	2	6	
Tea or lemonade with 1 tsp. sugar	10			
	—	—	—	—
	52	27	12	424
SUPPER:				
1 h. tbsp. brains scrambled with 1 egg; ½ tsp. butter	..	22	6	
Egg plant en casserole	5	4	2	
Buttered asparagus	4	2		
Fruit salad; ½ each medium size orange and ½ grapefruit with obesity mayonnaise	10			
Baked custard	10	9	6	
1 Uneeda biscuit	4	1		
Tea with saccharin				
	—	—	—	—
	33	38	16	428
Total	107	99	32	1,112

THURSDAY

	Carbohydrate	Protein	Fat	Calories
BREAKFAST:				
1 m. s. orange	10			
A. h. broiled fish with lemon or meat, no fat	..	22		
2 zwieback; 1 tsp. butter	22	2	6	
Cup coffee or tea with saccharin				
	32	24	6	270
DINNER:				
1 m. serving (1½ slices) roast beef, no fat	..	30	2	
Tomato or mushroom sauce				
1 small baked potato	16	2		
2 h. tbsp. cabbage or cauliflower	3	1		
A. h. lettuce salad, obesity mayonnaise	3			
Orange jello made with saccharin	4	3		
2 Graham crackers	12	2	2	
½ glass butter milk	5	3		
½ tbsp. butter	..	..	6	
	43	41	10	426
SUPPER:				
1 lean lamb or mutton chop	..	22		
Baked stuffed tomato	8	2	2	
1 h. tbsp. creamed corn	9	1		
1 Uneeda biscuit; 1 tsp. butter	4	1	5	
3 stuffed celery stalks	1	4	7	
Orange spanish cream	12	6		
Tea with saccharin				
	34	36	14	406
Total	108	100	30	1,102

LACTOVEGETARIAN DIETS*

Sunday

Breakfast:
Average sized peach or orange
2 tbsp. cottage cheese with 1 tsp. sugar and 2 tbsp. cream
1 piece zwieback
Cup cocoa 617 calories.

Dinner:
Large tomato, stuffed
1 tbsp. creamed potatoes
2 h. tbsp. buttered beets
Spinach salad, garnished with 1 tsp. raw grated carrots and ½ tbsp. mineral oil mayonnaise
2 heaping tbsp. orange ice
1 glass milk
½ tbsp. butter 768 calories.

Supper:
1 medium size slice toast with 1 tbsp. dry American cheese sprinkled on and melted in oven. Serve hot
3 heaping tbsp. carrots with butter ½ tbsp.
2 h. tbsp. beet greens or spinach
Asparagus salad (5 stalks canned), with mineral oil mayonnaise
3 h. tbsp. junket
1 glass milk 547 calories.
Total calories... 1,932

Monday

Breakfast:
1 average sized orange
1—1 cubic inch American cheese on 2 Uneeda biscuit and toasted
1 cup cocoa 460 calories.

Dinner:
2 h. tbsp. mashed potato
Egg plant en casserole
Medium tomato stuffed with celery, green pepper, a few bread crumbs, seasoned and baked
Lettuce salad with cheese dressing
1 tbsp. butter
1 zwieback
3 tbsp. junket
1 glass milk 765 calories.

Supper:
Cauliflower en casserole
3 heaping tbsp. carrots
Small green pepper stuffed with vegetables, seasoned with celery, tomato, cabbage, etc., and baked
Orange jello made with ½ gl. orange juice
No sugar, ½ tbsp. gelatin
2 Uneeda biscuit
1 glass milk
1 tbsp. butter 490 calories.
Total calories,... 1,715

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* The caloric values of these diets vary; those of highest values must often be reduced in carbohydrate or fat content.

Tuesday

Breakfast:

½ m. s. grapefruit
1 a. s. bread toasted
Butter 1 tsp.
Cup cocoa 435 calories.

Dinner:

1 small baked potato, stuffed with 1 inch cube dry cheese; sprinkled on and baked
2 h. tbsp. cauliflower, buttered
2 h. tbsp. squash
M. s. tomato salad stuffed with celery and cucumber
½ tbsp. mayonnaise mineral oil
Bran muffin
Orange jello with 2 tbsp. butter 717 calories.

Supper:

A. h. spinach or beet green with 2—1 inch strips of toast
3 h. tbsp. buttered carrots
Stuffed celery salad
2 Graham crackers
Glass milk
½ tbsp. butter 633 calories.
Total calories, ... 1, 785

Wednesday

Breakfast:

½ m. s. grapefruit
1 zwieback with ½ tsp. butter
Cup cocoa
3 h. tbsp. junket 487 calories.

Dinner:

Egg plant en casserole
1 small baked potato
2 h. tbsp. cabbage or cauliflower
Stuffed tomato salad
1 glass milk
Fruit cup 1 orange, ½ grapfruit and 1 slice pineapple
2 saltines and 1 inch cube American cheese
½ tbsp. butter 631 calories.

Supper:

5 stalks buttered asparagus served on 1 small slice toast
2 h. tbsp. string beans
Cauliflower en casserole
Spinach salad with mineral oil mayonnaise
Orange jello with 1 tbsp. thin cream
1 glass milk
1 tsp. butter 483 calories.
Total calories, ... 1,601

Thursday

Breakfast:
½ glass orange juice
1 zwieback with 1 c. inch neufchatel or cream cheese
Cup cocoa 461 calories.

Dinner:
3 h. tbsp. creamed celery
2 h. tbsp. buttered beets
Egg plant en casserole
1 m. s. slices tomato salad with cheese dressing
2 Uneeda biscuit
1 h. tbsp. orange sherbet
1 gl. milk
1 tsp. butter 702 calories.

Supper:
Baked stuffed tomato
Buttered turnips or cauliflower
1 h. tbsp. stewed corn
Spinach salad
½ tsp. butter
Lemon Jello
1 glass milk 441 calories.
Total calories,.................................... 1,604

Friday

Breakfast:
1 a. s. orange
1 tbsp. cottage cheese with 1 tsp. sugar and 1 tbsp. cream
1 Uneeda biscuit
½ tsp. butter
1 cup cocoa 499 calories.

Dinner:
Baked stuffed tomato
2 h. tbsp. squash
2 h. tbsp. spinach, garnished with 2 strips carrots and 2½ in. strips toast
3 stalks of stuffed celery
Baked pear
½ tbsp. butter
1 glass milk 650 calories.

Supper:
1 tbsp. creamed potatoes served with 1 medium tomato sliced and broiled
1 m. s. boiled and buttered onion.
A. s. beet salad with 1 tsp. green peas with mineral oil mayonnaise
1 tsp. butter
3 h. tbsp. junket
1 gl. orange juice 405 calories.
Total calories 1,554

SATURDAY

BREAKFAST:

1 a. s. orange or grapefruit or 2 h. tbsp. strawberries
1 small slice toast and ½ tsp. butter
1 cup cocoa 358 calories.

DINNER:

1 small baked potato
Cauliflower en casserole
2 h. tbsp. squash
Spring salad (average helping; tomato, cucumber, onion, etc.; served on lettuce with vinegar or mineral oil mayonnaise)
3 h. tbsp. junket with 1 tbsp. whipped cream
1 tsp. butter
1 glass orange juice 571 calories.

SUPPER:

2 m. s. carrots broiled
2 h. tbsp. stewed tomatoes
2 h. tbsp. string beans
1 tsp. butter
Orange sherbet
1 glass milk 552 calories.
Total calories 1,481

SKELETON DIET

The following is a skeleton diet devised by Umber to which additions can be made according to the needs and tastes of the patient. This amount of food (881 calories) is to be taken daily, and the patient is expected on the advice of the physician to add 100 calorie portions taken from the subjoined list.[14]

TABLE 1.—*Skeleton Diet Devised by Umber*

		N	Protein	Fat	Carbohydrate	Calories
Morning	200 cm. coffee or tea	0.1				
	20 cm. milk	0.1	0.6	0.7	0.9	13
	50 Gm. Graham bread	0.5	3.0	0.25	25.0	117
	30 Gm. White bread (roll)	0.3	2.1	0.14	17.0	80
Mid-morning	100 grapefruit	.....	0.36	....	12.0	51
Lunch	200 Gm. roast beef or similar meat	8.4	52.8	4.0	.....	254
	200 Gm. vegetables, cooked in saltwater	0.6	4.0	....	10.0	58
	80 Gm. fruit	.....	0.28	....	9.6	41
Mid-afternoon	150 cm. coffee	0.07				
	20 cm milk	0.1	0.6	0.7	0.9	13
Supper	100 Gm meat	4.2	26.4	2.0	.....	127
	100 Gm. vegetables	0.3	2.0	....	5.0	29
	20 Gm. Graham bread	0.2	1.2	0.1	10.0	47
	200 cm. tea	0.1				
Bedtime	100 Gm. fruit	.....	0.36	....	12.0	51
	Total	14.97	95.70	7.89	102.4	881

Possible additions to be made to the foregoing diet. Each portion in the amount stated carries 100 calories.

80.0 Gm.	Roast beef
200.0 Gm.	Oysters
40.0 Gm.	White bread, Graham bread.
30.0 Gm.	Zwieback
12.5 Gm.	Butter
20.0 Gm.	Swiss or Edam cheese
25.0 Gm.	Sugar
100.0 Gm.	Potatoes
30.0 Gm.	Rice, lentils, beans. (uncooked)
20.0 Gm.	Oatmeal or farina. (uncooked)
200.0 Gm.	Apple
150.0 Gm.	Apple stew
500.0 Gm.	Berries
150.0 Gm.	Milk
150.0 Gm.	Wine

(A complete table of 100 calorie portions will be found at the end of the book.)

OBESITY RECIPES

Escalloped Fish:

	Protein	
2 heaping tbsp. fish flakes	21	
1 egg white	4	
1 tsp. butter		
Seasoning—water to moisten; bake in individual molds		
	25	100
		79 calories.

Mineral Oil Mayonnaise:

1 egg
2 cup mineral oil
1 tsp. salt
1 tsp. mustard
Paprika; make as any other mayonnaise

Peach Whip:

	Protein	Calories
6 halves unsweetened peaches		
1 egg white; whip egg stiff and mix with peaches which have been peeled and mashed; sweeten with saccharin	4	36

Carrot Omelet:

2 h. tbsp. mashed carrots	1	
1 egg beaten separately and mix as for fluffy omelet; add carrots and season	6	
	7	101

Cauliflower en Casserole:

2 h. tbsp. cooked cauliflower. Season, put in casserole and sprinkle with 1 tsp. American cheese and 1 tsp. cracker crumbs and bake. Moisten with juice of cauliflower. 6 99

Egg Custard:

	Protein	Calories
1 egg	6	83
⅓ glass skim milk	3	28
Sweeten with saccharin	9	111

Spinach Salad:

2 h. tbsp. cold spinach pressed in mold, chill and serve on lettuce leaf		
	2	57

Lemon Jello:

1 tsp. gelatin
1 tbsp. cold water
½ lemon for juice
4 tbsp. hot water
2 tsp. sugar.

Bran Muffins:

	Carbohydrate	Protein	Fat	Calories
1 egg				
1 cup butter milk				
1 tbsp. melted fat				
½ cup flour				
½ cup meal				
1 cup Kellogg's bran				
1 heaping tsp. baking powder				
½ tsp. soda				
½ tsp. salt				
Makes 12 muffins, each containing	8	2	2	48

Egg Plant and Oysters en Casserole:

	Carbohydrate	Protein	Fat	Calories
2 h. tbsp. egg plant	3	3		
3 average sized oysters	2	..	8	104
1 tsp. butter				
Cook egg plant as usual; chop oysters and mix; add seasoning and sprinkle with 1 tsp. cracker crumbs and bake				
	5	3	8	104

Orange Ice:

	Carbohydrate	Protein	Fat	Calories
2½ cups orange juice				
¼ lemon				
1½ sugar				
1 cup water				
Rind of 2 oranges				
	75	1	..	312

LACTOVEGETARIAN RECIPES

Orange Jello:

	Protein
½ tbsp. gelatin	3
1 tbsp. water	
1 tbsp. lemon juice	
2 tbsp. orange juice	
2 tsp. sugar	
¼ c. boiling water	
Made without sugar	

Orange Ice:

2½ cups orange juice
¼ c. lemon juice
1½ c. sugar
1 c. water
Rind 2 oranges
2 h. tbsp. 312 calories.

Cocoa:

1 h. tsp. cocoa
1 h. tsp. sugar
¾ c. milk
1 tbsp. cream
1 cup contains 279 calories.

Junket:

Make with junket tablets as directed when purchased
3 tbsp. contains 85 calories.

Cheese Dressing:

Grate 1 cubic inch of dry American cheese and mix with 1 tbsp. mineral oil mayonnaise. 91 calories.

Egg Plant en Casserole:

2 h. tbsp. egg plant cooked
3 oysters
1 tsp. butter
1 tsp. cracker crumbs
Mix and bake in casserole 77 calories.

Cauliflower en Casserole:

2 h. tbsp. cauliflower cooked
1 tbsp. dry American cheese
½ tsp. butter
1 tsp. cracker crumbs
Put in casserole; sprinkle with the cheese and crackers
Season and bake 139 calories.

Stuffed Tomato, Baked:

Select large round tomato, scoop out center and mix with celery, green pepper, a little onion; season, add 1 tsp. butter; put back into tomato, sprinkle with 1 tsp. cracker crumbs and 1 tsp. dry grated cheese. 103 calories.

Stuffed Celery:

6 small stalks celery
2 tbsp. Amer. or Roquefort cheese
Cream with 2 tbsp. cream and season
Contains Carbohydrates 2 Proteins 7 Fat 13 Calories 198

Spinach Salad:
2 h. tbsp. spinach seasoned, pressed into mold and chilled
Serve on lettuce leaf
½ tbsp. mayonnaise 142 calories.

Stuffed Tomato Salad:
Scoop out medium sized tomato; mix with celery, green pepper, carrots, etc., and mineral oil mayonnaise; season and refill; serve on lettuce leaf. 50 calories.

HISTORIC REDUCTION CURES

Certain reduction diets have achieved fame because of the results claimed for them by their authors. The approximate food values of the best known of these are given below.[13]

Table 2.—*Food Values of Best Known Reduction Diets*

	Protein	Fat	Carbohydrate	Total Calories
Banting	170–180	7.5	80– 85	1,200
Oertel	150–170	25– 45	75–120	1,200–1,600
Ebstein	105	60–100	75– 50	1,400
Von Noorden	120–180	40	100–120	1,180–1,500

Two diets characteristic of the intensive reduction regimen used by many clinicians are given below. *Ebstein's*[16] *diet* in detail follows:

Ebstein's Diet

Breakfast: A large cup of tea without milk or sugar, 50 Gm. of toast, with 20 or 30 Gm. butter

Lunch: Meat soup made with bone marrow or similar material rich in fat; from 120 to 180 Gm. boiled or roast meat with preference for the fatter varieties; vegetables and vegetable purees; stewed apple without sugar; lettuce; fresh fruit (strawberries, cherries, apple)
After lunch a large cup of black tea without sugar

Supper: A cup of tea; one egg; roast beef, ham (with the fat), sausage, or fish; 30 Gm. white bread with butter; a little cheese; fresh fruit.

Von Noorden's Diet

Von Noorden's intensive reduction cure is planned along different lines and is more in accordance with today's accepted rules. He prescribes:[13]

Breakfast: A small roll, 80 Gm. cold lean meat, tea or coffee with a dessert-spoonful of milk but without sugar

10 a. m. Bouillon with yolk of egg

Lunch: Bouillon; green vegetables; 150 Gm. lean meat or fish; 100 Gm. potatoes; leafy vegetables; cabbage, cauliflower or asparagus; 100 Gm., fish or cooked fruit (without sugar)

4 p. m.: Tea or coffee, glass of skim milk, 200 Gm. fresh fruit

Supper: 125 Gm. lean meat, 30 Gm. Graham bread; a liberal helping of cooked fruit without sugar; pickles or radishes. One glass of wine twice daily between meals to prevent hunger.

TABLE 3.—*Ready Reference Table for Determining the Proper Caloric Intake for the Reduction Cure in a Man or Woman of Given Height and Age**

* Weights are given in kilograms and express the *calculated ideal weight*. The calories prescribed represent 20 and 25 calories per kilogram of ideal weight (prepared by James B. McLester).

MEN

Height	inches	60	61	62	63	64	65	66	67	68
	cm	152	155	157	160	163	165	168	170	173
Age, Years										
25	Kilo (ideal)	55	56	57	59	61	63	64	66	68
	cal	1,110–1,375	1,125–1,410	1,145–1,430	1,170–1,465	1,210–1,510	1,245–1,555	1,280–1,600	1,315–1,645	1,355–1,690
27	Kilo ”	56	57	58	59	61	63	64	66	68
	cal	1,125–1,410	1,145–1,430	1,160–1,455	1,190–1,485	1,215–1,520	1,255–1,565	1,290–1,610	1,325–1,655	1,360–1,700
29	Kilo ”	57	58	59	60	62	64	65	67	69
	cal	1,145–1,430	1,160–1,455	1,190–1,485	1,210–1,510	1,235–1,545	1,270–1,590	1,305–1,635	1,345–1,680	1,380–1,725
31	Kilo ”	58	59	59	61	62	64	66	68	69
	cal	1,155–1,440	1,170–1,465	1,190–1,485	1,215–1,520	1,245–1,555	1,280–1,600	1,315–1,645	1,355–1,690	1,390–1,735
33	Kilo ”	58	59	59	61	62	64	66	68	70
	cal	1,155–1,440	1,170–1,465	1,190–1,485	1,215–1,520	1,245–1,555	1,280–1,600	1,315–1,645	1,355–1,690	1,395–1,750
35	Kilo ”	58	59	60	61	63	65	66	68	70
	cal	1,160–1,455	1,180–1,475	1,200–1,500	1,225–1,530	1,255–1,565	1,290–1,610	1,325–1,655	1,360–1,700	1,405–1,760
37	Kilo ”	59	59	60	62	64	65	67	69	71
	cal	1,170–1,465	1,190–1,485	1,210–1,510	1,235–1,545	1,270–1,590	1,305–1,635	1,345–1,680	1,380–1,725	1,425–1,780
39	Kilo ”	59	60	61	62	64	65	67	69	71
	cal	1,180–1,475	1,200–1,500	1,215–1,520	1,245–1,555	1,270–1,590	1,305–1,635	1,345–1,680	1,380–1,725	1,425–1,780
41	Kilo ”	59	60	61	63	64	66	68	69	72
	cal	1,190–1,485	1,210–1,510	1,225–1,530	1,255–1,565	1,280–1,600	1,315–1,645	1,355–1,690	1,390–1,735	1,435–1,795
43	Kilo ”	60	61	62	63	64	66	68	70	72
	cal	1,200–1,500	1,215–1,520	1,235–1,545	1,260–1,580	1,290–1,610	1,325–1,655	1,360–1,700	1,405–1,760	1,445–1,805
45	Kilo ”	60	61	62	64	65	67	69	70	73
	cal	1,210–1,510	1,225–1,530	1,245–1,555	1,270–1,590	1,300–1,625	1,335–1,670	1,370–1,715	1,405–1,760	1,455–1,815
47	Kilo ”	61	62	63	64	65	67	69	71	73
	cal	1,215–1,520	1,235–1,545	1,255–1,565	1,280–1,600	1,305–1,635	1,345–1,680	1,380–1,725	1,415–1,770	1,460–1,825
49	Kilo ”	61	62	63	64	65	67	69	71	73
	cal	1,215–1,520	1,235–1,545	1,255–1,565	1,280–1,600	1,305–1,635	1,345–1,680	1,380–1,725	1,415–1,770	1,460–1,825

Height	inches	69	70	71	72	73	74	75	76
	cm	175	177	180	183	185	188	190	192
Age, Years									
25	Kilo (calculated ideal)	69	71	74	76	79	81	84	86
	cal.	1,390–1,735	1,425–1,780	1,470–1,840	1,515–1,895	1,570–1,965	1,625–2,030	1,670–2,085	1,715–2,145
27	Kilo " "	70	72	74	77	79	82	85	87
	cal.	1,395–1,750	1,435–1,795	1,480–1,850	1,535–1,920	1,590–1,985	1,645–2,055	1,700–2,120	1,740–2,180
29	Kilo " "	70	73	75	78	80	83	86	88
	cal.	1,415–1,770	1,455–1,815	1,500–1,870	1,550–1,940	1,610–2,010	1,660–2,075	1,715–2,145	1,760–2,200
31	Kilo " "	71	74	76	79	81	84	87	89
	cal.	1,425–1,780	1,470–1,840	1,515–1,895	1,570–1,965	1,625–2,030	1,680–2,095	1,730–2,170	1,790–2,235
33	Kilo " "	72	74	77	79	82	85	88	90
	cal.	1,445–1,805	1,490–1,860	1,535–1,920	1,590–1,965	1,645–2,055	1,700–2,120	1,750–2,190	1,805–2,260
35	Kilo " "	73	75	77	80	83	86	88	91
	cal.	1,455–1,815	1,500–1,870	1,545–1,930	1,600–2,000	1,650–2,065	1,715–2,145	1,770–2,215	1,825–2,260
37	Kilo " "	74	76	78	81	84	87	89	92
	cal.	1,470–1,840	1,515–1,895	1,560–1,950	1,615–2,020	1,670–2,085	1,730–2,170	1,790–2,235	1,835–2,290
39	Kilo " "	74	76	79	81	84	87	90	93
	cal.	1,470–1,840	1,525–1,895	1,570–1,965	1,625–2,030	1,680–2,095	1,740–2,180	1,805–2,260	1,860–2,325
41	Kilo " "	74	76	79	82	84	88	90	94
	cal.	1,480–1,850	1,525–1,905	1,580–1,975	1,635–2,045	1,690–2,110	1,750–2,190	1,815–2.270	1,880–2,345
43	Kilo " "	75	77	79	82	85	88	91	94
	cal.	1,490–1,860	1,535–1,920	1,590–1,985	1,645–2,055	1,700–2,120	1,760–2,200	1,825–2,280	1,890–2,360
45	Kilo " "	75	78	80	83	85	89	92	95
	cal.	1,500–1,870	1,545–1,930	1,600–2,000	1,650–2,065	1,705–2,135	1,770–2,215	1,835–2,290	1,900–2,370
47	Kilo " "	75	78	80	83	86	89	93	96
	cal.	1,505–1,880	1,550–1,940	1,615–2,020	1,660–2,075	1,725–2,155	1,790–2,235	1,850–2,310	1,915–2,390
49	Kilo " "	75	78	80	83	86	89	93	96
	cal.	1,505–1,880	1,550–1,940	1,615–2,020	1,660–2,075	1,725–2,155	1,790–2,235	1,850–2,310	1,915–2,390

TABLE 3.—*Ready Reference Table for Determining the Proper Caloric Intake for the Reduction Cure in a Man or Woman of Given Height and Age** (*Continued*)

* Weights are given in kilograms and express the *calculated ideal weight.* The calories prescribed represent 20 and 25 calories per kilogram of ideal weight (prepared by James B. McLester).

WOMEN

Height { inches		56	57	58	59	60	61	62	63	64
Height { cm		142	145	147	150	152	155	157	160	163
Age, Years										
25	Kilo (ideal)	49	50	51	52	53	54	55	56	58
	cal.	990–1,235	1,005–1,260	1,025–1,280	1,045–1,305	1,060–1,325	1,080–1,350	1,100–1,375	1,125–1,405	1,160–1,450
27	Kilo "	50	51	52	53	54	54	55	57	59
	cal.	1,000–1,250	1,015–1,270	1,035–1,295	1,055–1,315	1,070–1,340	1,090–1,360	1,110–1,385	1,135–1,420	1,170–1,465
29	Kilo "	50	51	52	53	54	55	56	57	59
	cal.	1,005–1,260	1,025–1,280	1,045–1,305	1,060–1,325	1,080–1,350	1,100–1,375	1,120–1,395	1,145–1,430	1,180–1,475
31	Kilo "	51	52	53	54	55	56	57	58	60
	cal.	1,025–1,280	1,045–1,305	1,060–1,325	1,080–1,350	1,100–1,375	1,120–1,395	1,135–1,420	1,160–1,450	1,200–1,500
33	Kilo "	52	53	54	54	55	56	57	59	60
	cal.	1,035–1,295	1,055–1,315	1,070–1,340	1,090–1,360	1,110–1,385	1,125–1,405	1,145–1,430	1,170–1,465	1,210–1,510
35	Kilo "	52	53	54	55	56	57	58	59	61
	cal.	1,045–1,305	1,060–1,325	1,080–1,350	1,110–1,375	1,120–1,395	1,135–1,420	1,155–1,440	1,180–1,475	1,215–1,520
37	Kilo "	53	54	54	55	56	57	59	60	62
	cal.	1,055–1,315	1,070–1,340	1,090–1,360	1,110–1,385	1,125–1,405	1,145–1,430	1,170–1,465	1,200–1,500	1,235–1,545
39	Kilo "	54	54	55	56	57	58	59	61	63
	cal.	1,070–1,340	1,090–1,360	1,110–1,385	1,125–1,405	1,145–1,430	1,160–1,450	1,190–1,485	1,215–1,520	1,250–1,565
41	Kilo "	54	55	56	57	58	59	60	62	63
	cal.	1,090–1,360	1,110–1,385	1,125–1,405	1,145–1,430	1,160–1,450	1,180–1,475	1,210–1,510	1,235–1,545	1,260–1,575
43	Kilo "	55	56	57	58	59	59	61	62	64
	cal.	1,110–1,375	1,120–1,395	1,135–1,420	1,155 1,440	1,170–1,455	1,190–1,485	1,215–1,520	1,245–1,555	1,270–1,585
45	Kilo "	55	56	57	58	59	60	61	63	64
	cal.	1,110–1,385	1,125–1,405	1,145–1,430	1,160–1,450	1,180–1,475	1,200–1,500	1,225–1,530	1,250–1,565	1,280–1,600
47	Kilo "	56	57	58	59	59	60	62	63	64
	cal.	1,120–1,395	1,125–1,420	1,155–1,440	1,170–1,455	1,190–1,485	1,210–1,510	1,235–1,545	1,260–1,575	1,290–1,610
49	Kilo "	56	57	58	59	60	61	62	64	65
	cal.	1,125–1,405	1,145–1,430	1,160–1,450	1,180–1,475	1,200–1,500	1,215–1,520	1,245–1,555	1,270–1,585	1,300–1,620

Height	inches	65	66	67	68	69	70	71	72
	cm	165	168	170	173	175	178	180	183
Age, Years									
25	Kilo (calculated ideal)	59	61	63	65	67	69	70	72
	cal	1,190–1,485	1,225–1,530	1,260–1,575	1,300–1,620	1,335–1,665	1,370–1,715	1,395–1,750	1,435–1,795
27	Kilo ” ”	60	62	64	65	67	69	70	72
	cal	1,200–1,500	1,235–1,545	1,270–1,585	1,310–1,630	1,345–1,675	1,380–1,725	1,405–1,760	1,445–1,805
29	Kilo ” ”	60	62	64	66	68	69	71	73
	cal	1,210–1,510	1,245–1,555	1,280–1,600	1,315–1,645	1,355–1,690	1,390–1,735	1,415–1,770	1,455–1,815
31	Kilo ” ”	61	63	65	67	69	70	71	73
	cal	1,225–1,530	1,260–1,575	1,300–1,620	1,335–1,665	1,370–1,715	1,395–1,750	1,525–1,780	1,460–1,825
33	Kilo ” ”	62	64	66	68	69	71	72	74
	cal	1,245–1,555	1,280–1,600	1,315–1,645	1,355–1,690	1,390–1,735	1,415–1,770	1,445–1,805	1,470–1,840
35	Kilo ” ”	63	64	66	68	70	71	73	74
	cal	1,250–1,565	1,290–1,610	1,325–1,655	1,360–1,700	1,395–1,750	1,525–1,780	1,455–1,815	1,480–1,850
37	Kilo ” ”	64	65	67	69	71	72	74	75
	cal	1,270–1,585	1,310–1,630	1,345–1,675	1,380–1,725	1,415–1,770	1,445–1,805	1,470–1,840	1,500–1,870
39	Kilo ” ”	64	66	68	70	72	73	74	76
	cal	1,290–1,610	1,325–1,655	1,360–1,700	1,395–1,750	1,435–1,795	1,460–1,825	1,490–1,860	1,515–1,895
41	Kilo ” ”	65	67	69	70	72	74	75	76
	cal	1,300–1,620	1,335–1,665	1,370–1,715	1,405–1,760	1,445–1,805	1,470–1,840	1,500–1,870	1,525–1,905
43	Kilo ” ”	65	67	69	71	73	74	76	77
	cal	1,310–1,630	1,345–1,675	1,380–1,725	1,415–1,770	1,455–1,815	1,480–1,850	1,515–1,895	1,545–1,930
45	Kilo ” ”	66	68	69	71	73	74	76	78
	cal	1,315–1,645	1,355–1,690	1,390–1,735	1,425–1,780	1,460–1,825	1,490–1,860	1,525–1,905	1,550–1,940
47	Kilo ” ”	66	69	70	72	74	74	77	79
	cal	1,325–1,655	1,370–1,715	1,405–1,760	1,445–1,805	1,480–1,850	1,505–1,880	1,545–1,930	1,570–1,965
49	Kilo ” ”	67	69	71	73	75	76	78	80
	cal	1,335–1,665	1,380–1,725	1,415–1,770	1,460–1,825	1,500–1,870	1,525–1,905	1,560–1,950	1,590–1,985

It will be seen that the chief differences between the diets of Ebstein and von Noorden are that the former is high in fat and low in carbohydrate, while the latter is low in fat and relatively high in carbohydrate. The former is objectionable because it violates certain generally accepted rules of the reduction cure and also because it may upset the stomach. Such diets are of little practical interest to the American physician because he can with the help of a table of food values arrange in a few minutes a menu much better suited to American taste and digestion.

Special forms of diet have been proposed from time to time as possessing peculiar advantages. Three of these are deserving of mention: the potato cure, the milk cure and the lactovegetarian diet.

The potato cure of Rosenfeld possesses the advantage of being high in satiety value and low in calories. It prescribes large quantities of potatoes (from 800 to 1,200 Gm.), a little lean meat, little or no fat, and an abundance of water; it should not exceed in value 1,500 calories. Rosenfeld's menu follows:

Rosenfeld's Menu

BREAKFAST:	Tea with saccharin; from 30 to 40 Gm. roll; perhaps a little marmalade
9 a. m.	10 Gm cheese; water
10 a. m.	100 Gm. apple; water
NOON:	2 glasses of water; 1–2 plates of vegetable soup (no fat) thickened with potatoes; boiled or roast lean meat; potatoes, radishes, lettuce
2 p. m.	Tea with saccharin
3:30 p. m.	Six plums; water
5 p. m.	100 Gm. apple
SUPPER:	Two eggs and potato salad, or roast beef and vegetables

The *Karell milk cure* restricts not only the intake of food but of water as well, being designed primarily for patients with heart disease. It is simple and in suitable cases will at times work wonders. I have seen patients with myocardial failure accompanied by great edema markedly improved within a comparatively short time when placed on this regimen. Its advantages probably lie in its low caloric value, restricted fluid intake and small salt content. It should not be continued unchanged longer than a week or at most ten days, because of its monotony and its low protein content. Modifications of this diet have been proposed, but it is best used in its simplest form—800 cc. of milk is given in four portions (200 cc. each) at 8 a. m., 12 noon, 4 p. m. and 8 p. m. Sometimes it is advisable to add another feeding of milk and make the total 1 liter. The rule is to give no other food and no additional fluids but I have found that during the excessively hot weather of the Alabama summer it is essential that some additional fluid in the form of water be allowed. At the end of a week, soft boiled eggs, dry toast, cereals, and finally a little meat should be gradually added.

LEANNESS

A clear distinction should be drawn between leanness and inanition. The one is a personal characteristic, often inherited, while the other is an accompaniment of disease. Leanness is a relative term and is generally applicable to persons who are from 10 to 15 pounds underweight. This, and an even greater degree of thinness, is, however, often compatible with perfect health. There are two types: (*a*) the sthenic and (*b*) the asthenic.

The *sthenic type* of leanness is represented by a well defined group of thin persons who possess in greater or lesser degree the following characteristics: a fairly good musculature, endurance and stamina, normal resistance to disease, a well balanced nervous system and emotional poise. This characteristic constitution is in large part inherited. We can picture in these people a metabolic tendency which is exactly the opposite of that of constitutional obesity; instead of exhibiting an economic metabolism which utilizes its surplus food for the deposition of fat, they extravagantly burn all nutritive material and accumulate no surplus. Body structure, musculature and nervous system are all good; they simply deposit abnormally little fat in the subcutaneous tissues. It is remarkable with what little variation these people keep their body weight at a fixed figure for long periods of time, and it is still more remarkable that this maintenance of unvarying weight is relatively independent of food intake and is not accompanied by any ascertainable change in the metabolic rate.

The *asthenic type* has nothing in common with the type just described except the condition of underweight. These people are not only thin and apparently undernourished but they are lacking in endurance and present a fairly characteristic body structure. Today when we are learning so much about constitutional predisposition to disease, it is evident that they suffer from a definite constitutional weakness both physical and nervous. In build they portray the asthenic "habitus" and in their attitude toward the world they exhibit the "inadequate personality." Lack of stamina is a salient characteristic; for neither physically nor mentally are they able to meet the demands made on them. Their general musculature is poorly developed, and they often exhibit poor development of the arterial system with hypoplasia of the heart. The thorax is narrow and shallow. They have marked enteroptosis and, as many of the gastro-intestinal invalids belong in this class, they usually complain of all sorts of digestive disturbances. They are the victims of a vicious circle; because of poor development of the abdominal organs both as to musculature and as to secretory activity, they have poor digestion and become afraid to eat, which leads to greater weakness and this in turn to still greater impairment of digestion.

The two types described above are distinct. Most thin people fall clearly into one or the other group, and yet there are occasionally encountered borderline cases which cannot fairly be placed in either group. Treatment is unnecessary for people of the first group, the sthenic type; true we may occasionally benefit some of them by inducing them to eat a little more, but as a rule such advice is unnecessary. Patients of the second group and those who belong in the intermediary groups can be benefited greatly by diet and by other appropriate treatment. It is for the latter that the upbuilding regimen described below is intended.

EMACIATION

Emaciation is the result of starvation or of disease. Brugsch offers the following classification:

1. Emaciation produced by a deficient diet: (*a*) Complete inanition (starvation). (*b*) Incomplete inanition (from inadequate food, either as to quantity or quality).
2. Emaciation which comes from increased metabolism (hyperthyroidism, a typical example).
3. Emaciation from infection (acute or chronic infectious diseases).
4. Cachexia;—emaciation with progressive protoplasma degeneration (carcinoma).
5. Emaciation from diseases of metabolism (diabetes).

The symptoms presented by emaciated patients depend largely on the disease which caused the trouble, but there are certain characteristics which are common to all. Such patients experience loss of muscle as well as fat. Because of unevenness in the loss of fat as well as rapid muscle degeneration, they sometimes retain to a remarkable degree the fat deposits of certain parts of the body (breasts, hips, omentum) while in other parts they show marked emaciation with atrophy of the muscles. Pendulous abdomen, sunken cheeks, thin neck and extremely thin legs combine to present a characteristic picture. These people are lacking in endurance and are completely atonic. The least exertion exhausts them. Emotional and other nervous symptoms often appear. Ambition and keenness of interest lags, and finally there comes emotional instability.

Diets suitable for these patients will be discussed in other parts of this book with the diseases which produce emaciation.

PRINCIPLES OF THE UPBUILDING DIET

If a lean person can be induced to take sufficient food and can be prevented from burning this up too rapidly (less exercise), he will usually put on weight. This increase in weight will benefit the general health of patients of the asthenic type sometimes to a remarkable degree. Nothing predisposes to nervousness so much as insufficient food, and few things allay emotional instability so satisfactorily as an abundant, well balanced diet. In arranging the diet of these patients, there should be three chief considerations: (1) the patient's distaste or fear of food must sometimes be overcome; (2) the total intake should be considerably in excess of the calculated maintenance; (3) the increase in body weight should include functioning protoplasm (muscle) as well as fat.

To accomplish the first it is advisable to keep the patient, at least for the first two or three weeks, in a hospital. If left to his own devices at home, even though he is given explicit directions, the asthenic patient will seldom take all of the food prescribed; either he gets tired of eating or he concludes that the food does not agree with him. This psychic element, while a stumbling block at home, is a rule easily overcome by the discipline of an institution. The patient should not be told in advance of what he is to eat. At definite intervals the food in prescribed quantities should be brought him, and he should be given to understand that he must eat all of it; to permit him to leave on his tray the least bit of food makes for poor morale. In answer to his statement that be cannot take milk, that acid fruits disagree with him, or that meat is bad for him, he must be told bluntly that his duty is to take what is set before him without question, and that the physician will be responsible for results. Unquestioning obedience must be demanded, and discipline should be inflexible. Soon the patient is aware that he begins to feel better and that, after all, the food has not hurt him. Then, progress as a rule becomes easy and rapid.

The total caloric value of the diet should be from 50 to 75 per cent above the maintenance diet. Accuracy is not essential; roughly, from 4,000 to 5,000 calories is appropriate for the average man or woman of ordinary height. The protein quota should be ample, say 100 to 120 Gm.; it may be in the form of any good protein, meat, eggs and milk. Carbohydrates should always furnish at least 50 per cent of the calories, and should be taken largely in the form of bread, cereals fruits and sugary foods. Fats in rather large quantities are given because of their higher caloric value; they are best taken in the form of cream, butter and bacon. In order to provide as many calories as possible, it is necessary to include in this diet many concentrated foods, but the necessity for roughage and particularly for vitamins should not be lost sight of. To secure these last food factors, the patient should be given a sufficient amount of milk, orange juice, tomatoes and always some leafy vegetable such as lettuce and spinach.

To insure muscle development as well as fat deposition is not always easy. This is best done by including in the diet a liberal amount of protein, and by prescribing as soon as possible suitable physical exercise. While the patient is in bed massage will help, but if he is out of bed regular exercise is necessary. Walking is best; golf for many reasons is excellent; and any of the systems of exercises which can be carried out in the bedroom are good. The chief desideratum is that the exercise be carried out regularly and according to some definite plan. Here again discipline should prevail.

Rapidity in the gain of weight should not be the chief object of this treatment, for great gains which are achieved in a short space of time are usually due solely to fat deposits. If the gain is more gradual and not too rapid, the patient is more likely to experience normal development of muscle and other structures. This procedure should as ar as possible be an upbuilding rather than merely a fattening process.

MILK AND EGG DIET

Milk is the food on which greatest dependence should be placed. It possesses two distinct advantages: (*a*) its great food value both as to caloric value and as to the character of its component foodstuffs, and (*b*) the ease with which relatively large quantities may be forced even in the absence of all appetite. Because of its lack of flavor and its fluid character, it is less objectionable to the patient with anorexia than other foods. True, these patients sometimes object even to milk, but the person who is cooperative in spite of anorexia can take milk when it is impossible for him to take other foods. Many people say that they cannot take milk, and they will tell of its disagreeable effects, all of which is largely imaginary. This in the vast majority of instances means merely that milk is distasteful to them. Unless there is a clear history of anaphylaxis from milk proteins, and this is rare, I insist that the patient take the milk as directed. Firmness sometimes brings excellent results.

Because of similar advantages, raw eggs are often prescribed in the upbuilding diet. Cooked eggs are to be preferred, but these sometimes have an objectionable flavor which fresh raw eggs have only to a small degree. Eggs, which have been beaten in milk, flavored and sweetened are often prescribed. This mixture has nutritive value and sometimes provides an agreeable variation, but for the patient who has no appetite and is trying to take large quantities of food they are an abomination. For these patients straight milk and straight raw eggs, taken separately, are as a rule infinitely better.

For the *milk diet* there is a little trick which I have found to work well with the patient in the hospital: Never tell him in advance what food he is to get; for the first three days give him nothing but milk—a large glass (250 cc.) every two hours from 7 a. m. to 9 p. m., and unless the milk is of average richness add a little cream. After three days, without previous notice, give him a tray containing a large attractive meal and tell him that he must eat all of it. As a rule, by this time his stomach and his psyche are ready for solid food, and he will take it. After this he should be given three large meals daily with interval feedings. The subsequent diet is given below.

UPBUILDING DIETS

SUNDAY

BREAKFAST:	
½ glass orange juice	
Shredded wheat biscuit	
1 soft boiled egg	
1 average sized piece toast with 1 tbsp. butter and 1 tbsp. marmalade	
1 glass milk	
6 tbsp. cream; 1 tbsp. sugar	1,136
10:30:	
1 glass milk; ⅓ cream	428
DINNER:	
1 poached egg on 3 heaping tbsp. mashed potatoes	
A. s. tomato salad with 1 tbsp. mayonnaise	
Spanish cream with 1 tbsp. whipped cream	
2 corn or whole wheat muffins with 1 tbsp. butter	
2 glasses milk	1,383
4 p. m.:	
1 glass malted milk	222
SUPPER:	
Average helping cream of pea soup with crackers	
1 egg omelet	
A. s. baked potato	
A. h. lettuce salad with thousand island dressing	
Rice custard; 2 slices of bread and 1 tbsp. of butter	
1 glass orange juice	1,052
BEDTIME:	
1 glass milk; ⅓ cream	428
Total Calories	4,649

Monday

Breakfast:	
4 large juicy stewed prunes	
4 h. tbsp. oat meal	
2 hot soda biscuits with 1 tbsp. butter and 1 tbsp. honey	
1 glass milk	
6 tbsp. cream and 1 tbsp. sugar	1,415
Dinner:	
A. h. roast lamb with 1 tsp. jelly	
2 h. tbsp. creamed corn	
Peas and carrots, 1 tbsp. each, salad on lettuce with French dressing (2 tsp.)	
2 hot French rolls with 1 tbsp. butter	
Chocolate custard with 1 tbsp. whipped cream	
2 glass milk	1,345
4 p. m.:	
1 glass orange juice with 1 tsp. sugar	140
Supper:	
1 egg souffle and cheese	
Baked spaghetti and tomato	
2 whole wheat muffins with 1 tbsp. butter	
2 h. tbsp. ice cream	
2 glass milk	1,126
Bedtime	
1 glass milk; ⅓ cream	428
Total calories	4,454

Tuesday

Breakfast:	
1 large baked apple with	
1 tbsp. whipped cream	
2 h. tbsp. Farina with 4 tbsp. cream and	
3 tsp. sugar	
1 soft boiled egg	
1 A. s. toast with 1 tbsp. butter	
1 cup rich cocoa	1,161
10 a. m.:	
1 glass milk; ⅓ cream	428
Dinner:	
2 heaping tbsp. creamed chicken on toast	
1 heaping tbsp. rice	
2 heaping tbsp. spinach with 1 hard boiled egg	
3 heaping tbsp. green peas	
3 stalks celery	
Spanish cream with 1 tbsp. whipped cream	
1 slice whole wheat bread and 1 tbsp. butter	
1 glass milk	1,319
4 p. m.:	
Malted or chocolate milk	221
Supper:	
Cream of corn soup with 2 Uneeda biscuits	
Poached egg on 2 heaping tbsp. mashed potatoes	
Apple and celery salad (½ of recipe)	
Tapioca pudding	
1 large slice brown bread and 2 tsp. butter	
2 glass milk	1,372
Bedtime:	
1 glass orange juice	100
Total calories	4,601

Wednesday

Breakfast:
1 glass orange juice
4 tbsp. oatmeal with 4 tbsp. cream and
2 tsp. sugar
2 hot biscuits with 1 tbsp. butter and 1 tbsp. honey
1 cup rich cocoa 1,246

Dinner:
1 poached egg in center of 3 heaping tbsp. mashed potatoes on hot plate
2 h. tbsp. green lima beans
A. s. lettuce salad with Thousand Island dressing
3 h. tbsp. tapioca pudding with
4 tbsp. cream
2 hot rolls with 1 tbsp. butter
1 glass milk; ⅓ cream 1,581

Supper:
6 panned oysters on large slice toast; 1 tsp. butter
2 heaping tbsp. creamed corn
Potato salad on lettuce
2 heaping tbsp. ice cream with
1 slice whole wheat bread with ½ tbsp. butter
1 glass milk; ⅓ cream 1,573

Total calories.. 4,400

Thursday

Breakfast:
1 large baked apple
1 shredded wheat biscuit
1 soft boiled egg
1 whole wheat muffin
Cup cocoa; ½ tbsp. butter
6 tbsp. cream; 2 tsp. sugar 1,163

Dinner:
Average helping roast beef, 1 slice with fat
Medium sized baked potato
Medium sized stuffed tomato salad with 1 tbsp. mayonnaise
2 h. tbsp. Spanish cream with 4 tbsp. cream
2 Corn muffins, or 2 average slices bread and 1 tbsp. butter
1 glass milk; ⅓ cream 1,877

Supper:
Cream cheese on 1 average slice toast
2 tbsp. grits or hominy with 1 tsp. butter
Apple and celery salad
2 h. tbsp. chocolate custard with 2 tbsp. cream
1 large whole wheat muffin; ½ tbsp. butter
1 glass milk; ½ cream 1,575

Total calories.. 4,615

Friday

Breakfast:

Prune sauce—4 large and juicy
5 heaping tbsp. grapenuts with 3 tsp. sugar and
4 tbsp. cream
1 soft boiled or shirred egg
2 medium slices toast, 1 tbsp. butter and
1 tbsp. heaping orange marmalade
Cup rich cocoa 1,282

Dinner:

A. h. roast lamb with 1 h. tbsp. jelly
2 h. tbsp. rice with ½ tbsp. butter
A. s. sweet potato
A. s. sliced tomato salad with ½ tbsp. mayonnaise
4 tbsp. soft custard
2 corn muffins or 2 whole wheat bread
1 tbsp. butter
1 glass milk; ⅓ cream 1,738

Supper:

2 egg omelet with 1 heaping tsp. butter
Medium size baked potato with 1 tsp. butter
2 h. tbsp. spinach
2 h. tbsp. rice or custard pudding with 1 tbsp. whipped cream
2 biscuits or muffins with 1 tbsp. butter
1 glass milk; ⅓ cream 1,418

Total calories.. 4,438

RECIPES

Desserts

Soft Custard:
½ cup milk
1 egg yolk
1 heaping tbsp. sugar
4 tbsp. contain 131 calories

Custard Pudding:
2 cup milk
2 eggs
¼ cup sugar
2 heaping tbsp. contain 183 calories

Rice Custard Pudding:
1 cup boiled rice
2 eggs
1½ cup milk
2 heaping tbsp. sugar
2 heaping tbsp. contain 179 calories

Malted Milk:
⅔ glass milk
1 heaping tbsp. malted milk contain 221 calories

Spanish Cream:
1 heaping tsp. gelatin
2 heaping tbsp. sugar
1 cup milk
1 egg
1 tbsp. sherry
2 h. tbsp. contain 204 calories

Chocolate Custard:
1 heaping tsp. chocolate
1 heaping tbsp. sugar
1 cup milk
1 egg
2 heaping tbsp. contain 200 calories

Tapioca Pudding:
2 cups milk
1 egg
3 tbsp. minute tapioca
2 tbsp. sugar
3 heaping tbsp. contain 172 calories

Ice Cream:
3 cups milk
1 cup cream
3 eggs
⅔ cup sugar
Vanilla
2 h. tbsp. contain 189 calories

Prepared Dishes

Cream Cheese on Toast:
1½ cup milk
2 heaping tbsp. butter } cream sauce
2 heaping tbsp. flour
3 tsp. American cheese
3 tbsp. cream sauce
Melt cheese in sauce and pour over 1 average size slice of toast and serve hot
Contains 200 calories

Egg and Cheese Souffle:
1 egg
1 tsp. grated cheese
1 tsp. butter, for pan
Whip white and yolk separately and beat all together. Season and bake in casserole in quick oven. Serve at once
Contains 210 calories

SALADS

Apple and Celery or Waldorf:
1 average size apple
3 small stalks celery
1 tbsp. mayonnaise
3 English walnuts
Cut apple and celery in small pieces and mix with mayonnaise. Serve on lettuce leaf. Chop walnut meats and sprinkle on top.
Contains 349 calories

Thousand Island Dressing:
1 tbsp. mayonnaise
Mixed with a bit of onions, carrots, green peppers, tomato, etc.
Contains 187 calories

Potato Salad:
1 medium size boiled potato
1 tbsp. mayonnaise
Cut potato in small cubes; mix with a bit of onion, green pepper, and some pickles. Chill and serve on lettuce
Contains 332 calories

French Dressing:
4 tbsp. salad oil
1 tbsp. vinegar
¼ tsp. salt
Pepper
2 tsp. contains 74 calories

TYPICAL GERMAN UPBUILDING DIET

The following diet-scheme devised by Umber is recommended by Brugsch:[15]

TABLE 4.—*Breakfast at 8 a. m.*

Gm.		Carbohydrate	Fat	Protein	Calories
250	Cream	10.57	56.65	9.4	607
100	Coffee				
100	Bread	56.6	.....	7.06	265
30	Butter	0.15	25.3	0.22	237
20	Sugar	20.0	.....	.....	82
		87.32	81.95	16.68	1,191
	Later to be added				
100	Eggs	.....	10.9	11.3	150
	or				
36	Egg yolk	.....	10.0	5.2	116
	or				
50	Bacon	.....	47.8	.....	445

This type of breakfast can be made to supply from 1,200 to 1,600 calories. Instead a large dish of oatmeal or other cooked cereal may be given, to which has been added an abundance of butter as well as cream.

TABLE 5.—*Lunch at 10 a. m.*

Gm.		Carbohydrate	Fat	Protein	Calories
200	Fat bouillon with 2 eggs..........	5.16	12.0	5.76	156
30	Beaten biscuit....................	21.90	1.5	3.3	117
20	Butter........................	.....	16.9	....	158
		27.06	30.4	9.06	431

Instead of the foregoing, the patient may be given grits or a glass of egg and milk (made with two eggs, 400 calories), or toasted bread with an abundance of butter and caviar.

TABLE 6.—*Meal at 1 p. m.*

Gm.		Carbohydrate	Fat	Protein	Calories
200	Bouillon with Farina, rice, tapioca.......	5.0	4.0	0.6	ca. 40
100	Roast meat........................	....	2.0	25.0	121.1
200	Vegetables with an abundance of butter, or macaroni, rice or noodles rich with butter and cream (up to 600 or 800 calories)........................	....	16–20	ca. 5.0	ca. 170 bis 207
200	Mashed potatoes with butter..........	....	30.0	6.0	ca. 300
	Preserved fruits......................	....	....	....	50–100
200	Carbohydrate puddings, fruit omelets, or cream cheese with toast, or salt crackers, with butter........................	38.6	7.2	6.6	ca. 250

At the foregoing meal the patient can easily be induced to take from 900 to 1,200 calories; with a good appetite, even more.

TABLE 7.—*Afternoon Tea*

Gm.		Carbohydrate	Fat	Protein	Calories
250	Tea or coffee with cream, or egg-milk, or 2 cups of cocoa, with biscuits........	10.57	56.65	9.4	607

8 p. m.

The evening meal should be simple and easily digested. Rice, Farina, tapioca pudding or corn pudding, with an abundance of butter is good (from 300 to 400 calories can thus be added). Toast with butter and perhaps a little cold meat may also be taken.

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CHAPTER XV

ANAPHYLAXIS AND FOOD POISONING

ANAPHYLAXIS AND PROTEIN INTOXICATION

Anaphylaxis and protein intoxication should be clearly distinguished for the one is a well defined disease entity while the other probably represents several different types of disturbance. Anaphylactic shock is the reaction which accompanies the introduction into the circulation or tissues of a protein to which the animal is specially sensitive, and is in all probability a true antigen-antibody reaction in which the protein molecule forms the antigen. Whole protein is necessary for this reaction. Incomplete proteins, such as gelatin and protein split-products, such as are found in peptone mixtures, will not produce anaphylaxis; they may cause grave disturbances, but these are due to protein intoxication, not to anaphylaxis. Sensitization is acquired by experimental animals through parenteral introduction of protein; in man it may be acquired by similar means (horse serum in diphtheria), but in most instances its origin is unknown.

The site of the essential change of the anaphylactic reaction is probably the cell, for, while both cellular and the humoral theories have adherents, it seems probable today that whatever the reactions in the circulation, the symptom complex which we call anaphylactic shock is produced by a union within the cell of antigen and antibody.

Wells[1] emphasizes the fact that studies of this phenomenon in the guinea-pig, rabbit and dog have shown that while the symptoms differ markedly as between species, they are always the same in the same species no matter what the protein used. The salient features are: in the guinea-pig, spasm of the bronchial musculature; in the rabbit, circulatory disturbance with a fall in arterial blood pressure and dilatation of the right side of the heart; and, in the dog, great engorgement of the liver and splanchnic circulation with depletion of the general circulation. He takes the view that differences in the distribution and development of nonstriated muscle account for the varying manifestations of this reaction; for, according to the proponents of this theory, it is the bronchial musculature of the guinea-pig, the muscular coat of the pulmonary arteries in the rabbit, and the musculature of the hepatic veins in the dog which show preponderance of development. The impact of the shock is no doubt felt by the smooth muscle everywhere, but presumably the organ in which the distribution and development of the muscle is greatest determines in each species the nature of its manifestations, as an example of which it has been pointed out that the perilous nature of anaphylactic shock in a person with chronic asthma is due to the greater development of his bronchial musculature. True, the reaction may be felt with equal force in other body cells, but it is the smooth muscle cell which records this phenomenon in the most graphic manner. There are at the same time changes in the metabolism of the cells and in the chemistry of the blood but just what part these changes play has not been demonstrated.

If the protein which produced the shock has been introduced in sufficient amount, the reaction is followed by a period of desensitization when further introduction of antigen will not cause anaphylaxis; the antibodies have all been exhausted. This condition is called anti-anaphylaxis. The same desensitization—and this is of great clinical importance—can be accomplished without the discomfort and danger of shock by introducing the antigen slowly and in sufficient dilution.

There seems to be a definite relationship between the anaphylaxis of experimental animals described above and certain food idiosyncrasies of man. Acute gastro-intestinal disturbances, especially in children, urticaria, eczema and asthma are often of this nature. Longcope[2] writes:

> These symptoms may vary from a mild rhinitis or localized urticaria to a violent condition of shock, with acute suffocation, asthma, terrific engorgement of the tissues of the neck and chest with collapse and death. The latter picture is rare unless the offending substance is introduced subcutaneously or intravenously, and though very alarming symptoms have followed the taking by mouth of proteins to which the patient is hypersensitive, death rarely, if ever, occurs under these latter conditions.

It is difficult to understand how the offending molecule while still intact can gain access to the general circulation in amounts sufficient to produce a reaction, but we know that absorption of the whole molecule does occur, for it has been shown that infants may absorb egg albumen and excrete it in identical form in the urine; there is experimental evidence that intestinal stasis favors such absorption.[3] There are numerous instances of typical sensitization to various protein foods, eggs, milk, pork and particularly sea food. Some persons are so sensitive that the absorption of even minute amounts of the offending protein will produce the most violent and alarming symptoms. The minuteness of the dose which will produce a reaction on such a person is almost unbelievable; for instance, there is the story[4] of the patient who was so sensitive to egg albumen that he could eat the meat of a rooster but could not eat that of a hen unless the viscera were carefully removed immediately after the bird was killed. In other instances appreciably larger amounts of protein are required for the production of a reaction; it is probable that in these cases gastrointestinal disturbances must prepare the way for absorption of the foreign protein.

Inherited predisposition usually plays a part in anaphylaxis, for hay-fever, asthma and food idiosyncrasies in various forms are often manifested by several members of the same family, and it is said that in 50 per cent of the cases a history of hypersensitiveness in one or both parents can be obtained. Heredity may impose direct sensitiveness to a particular protein or group of proteins, or it may merely render the person's cells prone to the development of hypersensitiveness in any form. In the latter instance, the chance absorption of small quantities of whole protein through the intestinal wall, or by some other route, determines the nature of the sensitization, and thereafter when the protein in question is introduced into the intestinal tract, minute quantities pass unchanged into the circulation to produce trouble.

Some investigators challenge the belief that food idiosyncrasies in man are of the nature of true anaphylaxis, and they assert that in the human subject all such reactions are due to mere protein intoxication. This is an extreme view, for there is definite evidence that some forms of asthma as well as other disturbances represent true anaphylaxis. This is a complex subject, however, and the whole story has not yet been told.

Protein Intoxication.—Many protein split-products are highly toxic when injected into man. An example of this form of intoxication is probably seen in the profound shock which accompanies high intestinal obstruction; a proteose which is formed in the obstructed loop is believed to be responsible. Intoxication of a similar nature may follow other forms of intestinal disturbance, but the exact nature of these poisons in the majority of instances is unknown; they usually cause shock in greater or less degree, with urticaria and other skin manifestations. Protein intoxication is usually associated with profound changes in protein metabolism and with the accumulation in the blood of large quantities of nonprotein nitrogen. In theory and in animal experiment, but not always in practice, it can be clearly distinguished from anaphylaxis.

MANIFESTATIONS OF ANAPHYLACTIC ILLNESS AND DIAGNOSIS

Duke[4] states that anaphylactic illness may be produced in several ways: 1. Symptoms referable solely to the intestinal tract may arise from direct contact between the gastro-intestinal mucous membrane and the product to which it is sensitive. 2. Symptoms referable to the gastro-intestinal tract or to distant organs may appear as a part of the general reaction to a protein after it has been absorbed and distributed by the blood. 3. When an organ is in an irritable state as a result of an anaphylactic reaction, it may be unduly disturbed by other factors, mechanical, chemical or thermic—which may be misleading to both physician and patient. 4. Illness which is in no way related to anaphylaxis may be made worse by an anaphylactic reaction; such, for instance, as exacerbation of the lightning pains of tabes dorsalis which was experienced by a sensitive person after eating apples or peaches. 5. Long continued or frequently repeated reactions may eventually lead to definite organic disease. It is possible that in this classification of reactions the author has in mind protein intoxication as well as true anaphylaxis.

The manifestations of anaphylaxis in man are numerous. Spasm of the bronchial musculature leading to asthma and certain skin changes, such as urticaria or eczema, are most frequent. The abdominal distress of a reaction may be local or general; it may be griping in character or a steady pain. Visual disturbances, arthritis, bladder irritability, extreme nervousness, profound weakness—any or all of these may appear. A characteristic feature of anaphylactic symptoms are their transient nature and the frequency with which they change their form. Intercurrent illness, such as an ordinary cold, may accentuate the symptoms of anaphylaxis, such as rhinitis or bronchitis, and thus create a false impression as to their severity.

The detection of the protein to which the person is specifically sensitive is aided by dermal or intradermal tests. Suspected proteins, either pure or in crude form, are introduced into the skin through small abrasions or scarified areas, and if the patient is sensitive to one of these, a wheal with a reddened areola appears at the point of introduction. In order to simplify the procedure when a large number of antigens must be tested, "group tests" may be used; several related proteins are mixed and used together for a single test. If a certain group gives a reaction, then each member of that group must in turn be separately tested. Proteins prepared for these tests either single or in groups may be secured in powdered form or in tablets.

This method of diagnosis has its limitations, for the skin test cannot always be relied on, owing largely to the fact that sensitiveness is not the same at all times. Not infrequently a patient will fail to experience anaphylactic shock from taking a protein to which his skin has reacted; conversely, the skin will not always react to the protein to which he is sensitive.

In making a diagnosis a searching inquiry into the circumstances leading up to past reactions is often of help but too much weight should not be given to the patient's own impressions or preconceived notions. Many people erroneously believe that they have an idiosyncrasy for certain foods; their statements should seldom be accepted without corroborating evidence. Final conclusion should be based on a disappearance of the symptoms when the suspected food is omitted from the diet and their reappearance when it is again taken.

TREATMENT

Treatment should be: (*a*) by avoidance or (*b*) by desensitization.

Simple avoidance is to be preferred when the food to which the patient is sensitive is unusual or nonessential. For example, the man who has urticaria and asthma from the eating of rice or of shell fish can escape by merely avoiding these articles, but if, on the other hand, the protein to which he is sensitive is a part of some necessary or common article of diet, avoidance is not so simple and he should, if possible, be desensitized. Milk and eggs, for instance, are used so universally in the cooking and preparation of food that it is impossible to avoid their proteins, and they are so necessary, especially for infants and children, that their avoidance should not even be attempted if other means of treatment can be made effective.

Desensitization is accomplished by the administration at frequent intervals and in subtoxic doses of the protein to which the person is sensitive. It may be given by mouth or hypodermically, but the oral route is the better and is the one usually chosen. The first dose must be extremely minute. As an example, for desensitization against milk proteins such high dilutions are used that the patient gets for the first dose, say, 1/20 of a drop of milk. This should be given three or four times during the day, and on the following day it may be increased to 1/18 or 1/15 of a drop. Gradually increasing doses, frequently repeated, always within the patient's tolerance, should be given until it is possible to take the offending food in the amounts in which it is ordinarily eaten. Other proteins may be diluted in a similar manner and taken by mouth or special preparations may be given hypodermically. The size of the initial dose which can be taken with safety varies in each case, and must be determined largely by the process of "trial and error." Since a gross error may be disastrous to the patient, great care should be taken in the beginning to attain extreme dilution and minute dosage. The length of time necessary to secure desensitization varies; it may require several months. After this has been accomplished, constant use of the food in question in liberal quantities is necessary to prevent a recurrence of sensitiveness.

Nonspecific protein injections are sometimes used in the effort to desensitize when the identity of the protein or proteins to which the patient is sensitive is unknown. This method has not given satisfactory results.

Epinephrine hydrochloride will often relieve the symptoms of anaphylaxis. Hypodermic doses of 0.2 to 1.5 cc. of a 1:1,000 solution are usually given. Ephedrin,[5] a Chinese drug of vegetable origin which has an action similar to epinephrine, but which has the great advantage of being active when taken by mouth, will probably be found useful in these states.

Protein intoxication can be treated only by avoidance, for there is no such thing as desensitization against protein split-products.

For a more complete discussion of anaphylaxis, the reader is referred to Wells'[1] monograph, and to Longcope's[2] article in "Endocrinology and Metabolism;" for antianaphylaxis and desensitization to Longcope's[7] monograph, and for treatment, to the articles by Schloss[4] and by Duke.[6]

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CHAPTER XVI

DISEASES OF THE KIDNEY AND URINARY TRACT

TYPES OF NEPHRITIS

As studied by the pathologist, nephritis may be divided into several distinct types, but for the clinician at the bedside such complex subdivision is not possible. True, the physician can occasionally foretell with a fair degree of accuracy the histopathology which will be found at necropsy, but such diagnostic precision is exceptional, and for clinical purposes it seems best to limit the classification of nephritis to such broader types as can be recognized during life. The following grouping has been suggested by Christian:[1]

A. Acute nephritis.
B. Subacute nephritis.
  1. Subacute nephritis with edema.
  2. Hemorrhagic nephritis.
C. Chronic nephritis.
  1. Chronic nephritis with edema.
  2. Chronic nephritis without edema.
  3. Vascular hypertension progressing into nephritis.

Etiology and disturbed physiology should be the guide in the arrangement of the diet. In the vast majority of instances, acute nephritis is caused by an infection, the best examples of which are seen in tonsillitis or scarlet fever. Intoxication, either from a bacterial product or from some other chemical agent is also a potent though less frequent factor; the diphtheria toxin, alcohol, turpentine and the heavy metals irritate the kidney and occasionally produce nephritis.

These two factors, bacterial invasion and chemical injury, are capable of producing chronic as well as acute nephritis, but repeated bacterial invasions of slight degree (as in chronic tonsillitis) or the ravages of long continued alcoholism, for instance, will result in chronic nephritis. It is possible that mild attacks of acute unrecognized nephritis result from these frequently repeated minute insults to the kidney and that through these attacks chronic nephritis finally ensues. This no doubt accounts for certain forms of chronic nephritis (chronic nephritis with edema), but it is significant that those patients whose cases fall in subgroups 2 and 3 of chronic nephritis in the foregoing classification (chronic nephritis without edema, and arterial hypertension) seldom give a history of acute nephritis. For the causes of these types we must probably look further.

What rôle does faulty diet play in the productin of chronic nephritis? Can overeating, especially of protein, initiate the disease? Or does such overindulgence act merely as a contributory factor after something else (infection?) has already injured the kidney? Also, can the susceptible person, as has been suggested by Longcope, acquire nephritis from eating the wrong food (anaphylaxis)? These questions have been variously answered. Newburgh[2] and his co-workers are convinced from their experiments on rabbits, rats and dogs that an excessive protein intake is injurious to the kidney. They lean to the view, however, that for the production of nephritis in man this factor must be combined with other destructive influences, and suggest that minute insults to the kidney, which alone are not capable of producing the disease, whether bacterial or chemical, will, when supplemented by physiologic overstrain from a high protein diet, cause chronic nephritis. A similar view is expressed by Allen[3] and his co-workers; they have been able to produce typical chronic nephritis in partially nephrectomized sheep and goats by giving them excessive amounts of protein or of salt. These experimenters feel that they are able by regulation of the diet of these animals to determine the symptoms and control the progress of the disease; they believe that the same can be done in man, and that physiologic rest for the kidney will lead to recovery even from pronounced nephritis. These results were not confirmed by Anderson,[4] who fed high protein diets to partially nephrectomized rabbits over long periods of time, in some cases about a year. He produced marked atherosclerosis of the aorta but no genuine nephritis. "The only change observed in the kidneys which might be attributed to the diet was a hypertrophy. There were no degenerative or inflammatory changes found except those of spontaneous origin." Similar results to those of Anderson were obtained by Jackson and Riggs,[5] who report that after feeding high protein diets to rats for about one third of the animal's life (from ten to twenty months) they were unable to recognize in these animals any evidence of nephritis. It is generally recognized that the kidney has a large factor of safety and that when intact it can stand great overstrain; it is only after it has been seriously injured that diet can become a determining factor. The workers first quoted, however, in support of their position assume that in man such predisposing kidney injuries are relatively frequent.

It is difficult to concede in certain forms of chronic nephritis that dietary faults play the prominent causative rôle thus accorded them.

Take, for example, that syndrome in which there appears first arterial hypertension without evidence of kidney disease but which is followed later by outspoken chronic nephritis (group three); it is evident here that nephritis is not the primary disorder. We must assume that some other condition comes first, possibly vascular injury involving the smaller organ arterioles, and that this is followed by disease of the kidney. If this be true, it is difficult to believe that excessive indulgence in protein is responsible. In this connection it is recalled that Aschoff[6] described certain fatty changes in the vessel wall as the first sign of arterial disease; one gathers from him the impression that altered fat metabolism rather than a surplus of protein disintegration products may in some way be responsible. The whole subject of the etiology of arteriosclerosis, and therefore of the chronic nephritis which seems to follow, is shrouded in doubt.

Whatever the ultimate cause of this type of nephritis, the one factor which we cannot ignore is heredity—an inherited constitutional predisposition. This is the one factor which we know to be of definite influence. Cardiovascular disease and chronic nephritis appear with great frequency in certain families; we often find disability of this character in several brothers and sisters, with predominance sometimes of cardiovascular symptoms, sometimes of renal manifestations and sometimes of the two in equal degree; and we read the same thing in the histories of their parents. The study of such families has not revealed common dietary faults or environmental influences which could reasonably be held responsible. Evidently there is an inherited predisposition. What is back of this it is impossible to say; some metabolic anomaly, or perhaps, a tendency to early degenerative change in the arteries.

METABOLISM IN NEPHRITIS

The metabolic rate in nephritis, as a rule, does not differ from that in health. There are two exceptions: it is increased by dyspnea and is decreased by edema. And, too, the patient's metabolic needs may be materially influenced by nausea and vomiting, by the restlessness and muscular twitching of uremia and by the loss of large quantities of albumen in the urine.

Protein utilization in nephritis is apparently the same as in health. Excessive protein destruction has occasionally been reported, but this is relatively rare; since it occasionally occurs in many other diseases, its true relationship to nephritis is a matter of doubt. In chronic nephritis with edema there is sometimes diminution in the total amount of serum protein with a relative, and sometimes an actual, increase in serum globulin. Fats are utilized in a normal manner. True, in certain types, particularly in chronic nephritis with edema, there is an increase in blood lipoids, which has led to the suggestion that the feeding of excessive amounts of fats in this disease is not a good thing. As a rule, however, a high fat diet is well taken care of provided carbohydrates are present in amounts sufficient to furnish at least 50 per cent of the calories. The utilization of carbohydrate also is normal. Because we often find increased sugar in the blood of nephritic patients, and because these people react to the glucose tolerance test with a blood sugar curve which is reminiscent of diabetes mellitus, it is sometimes assumed that they have a definite disturbance of sugar metabolism. It should be said, however, that this type of curve is seen in many other diseases of widely differing nature and that it is not a constant finding in nephritis. Two fairly satisfactory explanations of this have been offered: sclerosis of the pancreatic arteries may lead to a disturbance in sugar metabolism, and thus to an abnormal blood sugar curve; or renal injury may lead to increased blood diastase, which in turn is responsible for mobilization in the blood of great quantities of sugar. As a rule, however, nephritic patients metabolize cabohydrate well, and it should properly furnish their chief source of energy.

The increase in blood chlorides which is sometimes seen in nephritis is discussed below. An increase in blood phosphorus and a coincident reduction in blood calcium also accompanies nephritis; the phosphorus held in combination by lipoids and proteins behaves somewhat differently in this respect from inorganic phosphorus. An unusually high plasma phosphorus is believed to be of grave prognostic significance.

The acidosis of grave nephritis has been attributed to two causes: to retention of the acid products of protein destruction, and to inability of the kidney to deal with certain acid radicles, notably acid phosphates, which are normally excreted in the urine. Marriott and Howland attributed uremic acidosis largely to the latter cause.

There are four dietary factors which in their relation to the metabolism of the nephritic patient should receive special consideration: protein content, salt content, acid-forming qualities and total fluids.

The Protein Content of the Diet.—This has always been regarded as its most important feature. Because the soluble end-products of protein metabolism must be eliminated by the kidney, it is often assumed that in order to spare this organ we must rigidly curtail protein intake. The rationale of this rule is good, but in its practical application many mistakes are made. The protein metabolism of the normal person and that of the patient with chronic nephritis is essentially the same. Protein destruction continues at all times, and the resulting nitrogen waste products must pass through the kidney no matter how restricted the diet. Protein restriction cannot prevent this. On the other hand, if for long periods the protein of the diet is too rigidly curtailed, not only will no good accrue to the kidney, but the patient's general health and vigor will be impaired. The "wear and tear" requirement must be met by an adequate protein intake or the patient will inevitably suffer. In addition large amounts of protein are often lost in the urine and this, too, must be compensated for by an adequate intake. Chronic nephritis is not a disease of days or weeks, but of months and years, and it is necessary in this disease to provide a diet which will conserve the patient's strength through a long period, perhaps through many years.

While emphasizing the necessity for adequately covering the patient's protein requirements, we should bear in mind that these requirements can be reduced and nitrogen balance maintained at a relatively low level through the proper adjustment of the several dietary factors. A subcalorie diet appreciably lowers the basal metabolic rate, which in turn occasions less "wear and tear" and permits a lower level of nitrogen balance. Carbohydrate is a better sparer of protein than fat; therefore, to maintain nitrogen balance at the lowest level, the food should contain a liberal allowance of carbohydrate. The effort to preserve the full calorie value of the nephritic patient's diet with a large quota of fat is a mistake, for a diet high in fat will not permit economical utilization of protein. Sufficient calories to prevent loss of weight (except in the obese and near obese) and to preserve a reasonable amount of body fat is proper, but for protein economy the total caloric intake should not be excessive and carbohydrate should always form the chief source of energy.[7]

The attempt in the individual case to regulate protein intake according to predetermined nitrogen output is not practical. Mosenthal and Richards[8] have pointed out that even in health there is often a storage of protein, and that knowledge of intermediary protein metabolism is still so meager that it is not yet safe to make generalizations. They conclude: "A positive nitrogen balance cannot be interpreted as evidence of inability on the part of the kidneys to excrete protein waste products; nor is a negative balance a sign that the individual is overcoming the effects of such a retention."

The proponents of economy in nutrition believe that the average healthy man can get along well on a daily protein intake of from 40 to 50 Gm., while those who insist on the necessity for a liberal "factor of safety," place this figure at from 75 to 100 Gm. In an illness such as chronic nephritis the latter estimate may be shaved somewhat, say to 60 or 75 Gm. In acute nephritis, with its relatively short duration, the protein intake can be more rigidly restricted, say to even 20 or 25 Gm. daily. This very low protein intake cannot with safety be continued indefinitely, and as the disease becomes subacute or as the patient reaches that puzzling stage where he shows a little albumen in the urine but no other sign of disease, the protein allowance should be increased.

A form of chronic nephritis with edema, to which Friedrich Müller gave the name "nephrosis," is believed by Epstein[9] and others to be materially benefited by a liberal protein allowance and to be injured by rigid restriction. This will be discussed elsewhere.

The Salt Content of the Diet.—The kidney through its regulatory function so effectively controls the output of mineral elements that during health there is at all times preserved in the blood an unvarying concentration of salts and a constant osmotic tension. When the kidney is diseased this function becomes impaired. This is noticeably true of acute nephritis and of chronic nephritis with edema, in both of which the ability of the kidney to excrete chlorides is obviously impaired. This leads to the accumulation of these salts in the body fluids and eventually to edema. Because of this impairment, clinicians have for a long time restricted the salt in the diet of nephritis. The probable value of a "salt-poor" diet, one in which no salt is added to the food after it comes to the table and no unusually salty food is eaten, is generally recognized. Such a diet allows daily the equivalent of about 2 to 4 Gm. of sodium chloride. More recently, Allen has advised a "salt-free" diet, one in which all of the food is prepared without salt; even the bread contains no salt. On such a diet the patient gets only those chlorides which are contained in the native foods, approximately 0.5 Gm. daily. Allen is convinced that such rigid salt restriction is advisable in all forms of nephritis, even in so-called essential hypertension; he sees graphic improvement follow the institution of this salt-free regimen. McLester,[10] in a series of carefully controlled observations on a small number of patients with hypertension, in which the "salt-free" diet (about 0.5 Gm. NaCl) was used, was unable to find the improvement noted by Allen.

The following conclusions were reached by McLester:

1. The patient found the food unappetizing and usually ate little. This factor cannot be disregarded.
2. The blood urea instead of decreasing showed a tendency to increase.
3. The blood chlorides irrespective of diet varied little, while the urine chlorides reflecting the degree of the patient's adherence to the diet fell to a very low figure.
4. The systolic pressure as a rule showed a moderate fall. This was never marked.
5. In two of the patients weakness and prostration developed to a distressing degree.
6. One of the patients experienced retinal hemorrhages and other fundus changes at the end of two weeks while still on this diet.
7. From these observations I would conclude that the almost complete elimination of chlorides from the diet of patients with nephritis and vascular hypertension accomplishes little, if anything, more than does the salt-poor diet ordinarily prescribed.

Similar opinions have been expressed by Mosenthal and Short[11] and by others. It seems fair to conclude, then, that in all forms of nephritis, and perhaps even in arterial hypertension without apparent nephritis, the chloride intake should be somewhat restricted, and that when edema is present, it should be limited to that contained in the food as it reaches the table, which is the equivalent of about 2 Gm. of sodium chloride daily. Beyond this point salt restriction is unnecessary.

The Base or Acid-forming Qualities of the Diet in Nephritis.—This is deserving of some attention; it is difficult to say just how important it is. It has been suggested that an acid-forming diet may impair still further a diseased kidney by rendering its work more difficult, and that it may perceptibly increase the acidosis of impending uremia. Sansum[12] and his co-workers have studied the effects of basic diets on patients with nephritis and arterial hypertension. They advise that, in addition to the usual precautions, the diet be made predominatingly basic. They state that on such a diet "patients afflicted with arterial hypertension and chronic interstitial nephritis appear to improve, as evidenced by a fall in blood pressure, a reduction in urinary casts and albumen, and other symptoms referable to this combination of diseases, in 90 per cent of the cases. This study has demonstrated to us that many of the so-called normal diets contain far too large a proportion of the acid-forming foods, and we might theorize that such acid dietaries may be a factor in the etiology of blood vessel damage," Tables of basic and acid-forming foods and a sample base-forming dietary are given on page 479.

Water Balance.—Water balance is always important in nephritis. The custom once in vogue of prescribing for the nephritic patient excessively large quantities of fluid is bad. When the kidney cannot get rid of water, as is seen in the oliguria of acute nephritis, nothing is gained from a large intake; this should be limited to an amount which accords somewhat with the output. In acute nephritis with complete anuria von Noorden advised only a little cracked ice. This cannot be continued long, for a great deal of fluid is lost through the bowels, skin and lungs and must be replaced. Restriction of total fluids below 1 liter is seldom necessary. As the volume of urine increases, the allowance of fluid may be increased, but there is no reason why it should ever exceed 2 liters a day.

In chronic nephritis without edema there is no advantage in attempting to "wash out" the kidneys with great amounts of fluid or, on the other hand, to spare the heart and arteries with a rigidly restricted intake. A moderate intake is advisable, say from 1½ to 2 liters of total fluids a day.

Renal Impairment.—It is essential first of all to know that the patient actually has nephritis, and to formulate an opinion as to the degree of kidney impairment. The mere presence of albumen and an occasional cast in the urine does not call for rigid dietary restriction.*

To determine the safe protein allowance it is necessary to have not only a knowledge of the patient's nutritive needs but also an estimate of the extent of his renal impairment. The degree of retention in the blood of nitrogenous waste products can in the graver cases be taken as a rough guide. Estimations may be made of either blood urea or non-protein nitrogen; because it is more convenient, I prefer the former. It is a fairly safe rule that when the blood urea in chronic nephritis is high, the more rigid restriction is advisable; when it is normal a more liberal protein intake may be permitted.

In 1915, Mosenthal[13] modified the Hedinger and Schlayer test diet and showed that it gave a fair idea of the ability of the kidney to do its work. In this test the night urine is collected in one specimen and the day urine at intervals of two hours. Later it was shown by the same author[14] that the attention to detail called for by this test diet is unnecessary and that any normal diet will serve the same purpose. He gives the following directions for the "test day for renal function:"[15]

> Eat and drink what you are accustomed to but be sure that neither food nor drink is taken after supper until the test is completed. Note time and approximate amounts of food and fluid taken at each meal.
>
> 8.00 a. m. Void urine and discard the urine.
> 8.00 a. m. Eat breakfast.
> 10.00 a. m. Void urine and place all in a labeled bottle.
> 12.00 Noon Void urine and save as before.
> 1.00 p. m. Eat lunch.

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* The usual methods of recognizing nephritis and of evaluating the ability of the kidney to do its work can be found in the textbooks on diagnosis.

2.00 p. m. Void urine and save as before.
4.00 p. m. Void urine and save as before.
7.00 p. m. Void urine and save as before.
7.00 p. m. Eat supper.
10.00 p. m. Void urine and save as before.

All urine voided after 10.00 p. m. until 8.00 a m. is to be placed in a bottle labeled 8 00 a. m.

8.00 a. m. Void urine and place in the bottle labeled 8.00 a. m.

The following criteria are adopted for judging the efficiency of the kidney:

1. The specific gravity of the several specimens should vary within rather wide limits, and one or more specimens should go to 1,020 or higher.
2. The amount of night urine should as a rule not exceed 400 cc. although it may be as high as 750 cc. "An amount between 400 cc. and 750 cc. may be regarded with suspicion; a night urine exceeding 750 cc. is definitely pathological."
3. Concentration of sodium chloride, urea or total nitrogen in any of the specimens and the total quantity of these chemical bodies is of importance.

This test is satisfactory in giving as accurate a measurement of renal efficiency as any test at our disposal. It is a simple matter for a physician to take the specific gravity of several specimens of urine and to have the patient measure his night urine. If there is fixation of specific gravity with a nocturia exceeding, say 600 cc., he is safe in assuming that there is definite impairment of renal function.

ACUTE NEPHRITIS

Because this is a disease of short duration, the patient's nutritive requirements do not demand the careful consideration which they must have in chronic nephritis. Starvation of brief duration does no harm. In the severest cases in which there is nausea with vomiting, it is best to withhold all food for one or perhaps two days. When there is anuria or marked oliguria, the fluids should be limited to small quantities of water by mouth or perhaps cracked ice. From 500 to 1,000 cc. of tap water may be given by rectum; physiologic salt solution is not necessary; because of its chloride content, it may be distinctly harmful. A little later, or immediately in cases of moderate severity, the patient should be put on an all milk diet. The milk should be of average richness (not skimmed) and from 1½ to 2 pints should be given daily. As other articles are added, the amount of milk may gradually be reduced, say to two or perhaps three glasses daily. After one or two days of this diet, it is usually permissible to add cereals with cream (twice daily) and five or six slices of bread or toast with preserves and unsalted butter. Cooked fruits, such as baked apple or stewed prunes, may also be taken. Orange juice and other fruit juices are good.

For at least four weeks the food should consist largely of carbohydrate, with a reasonable amount of fat, and a minimum of protein and sodium chloride. After the first week or ten days the effort should be to approximate somewhat the patient's caloric needs. A nephritic patient weighing 150 pounds in bed should get from 1,500 to 1,700 calories. His protein should approximate 30 to 40 Gm. daily. No salt should be added to his food after it comes to the table. A quart of milk contains 40 Gm. of protein; and the average diet to which no salt has been added at the table carries the equivalent of about 2 Gm. of salt. After the first month, if the patient continues to improve, the protein quota can be increased, first to 50 Gm., then to 60 or perhaps even 75 Gm. daily.

The total amount of fluids taken should be limited at first to 800 or 1,000 cc. daily; at times it should be limited to an even smaller amount, especially if there is vomiting with edema. Later, it may be gradually increased to 1,200 or 1,500 cc. If the patient is purged or if he is treated by sweating and much fluid is lost through the skin, appropriate amounts should be added to his intake. Enough fluid to relieve thirst is necessary. As the output increases, it is safe also to gradually increase the intake.

Below is given a series of menus which are appropriate in the later stages of or in convalescence from acute nephritis. The protein content of each is given. The amount of salt, if none is added at the table, can be assumed to be roughly 2 Gm.

MENUS APPROPRIATE IN LATE STAGES OF ACUTE NEPHRITIS OR DURING CONVALESCENCE

SUNDAY*

	Protein	Calories
BREAKFAST:		
One sliced orange		
1 medium slice toast; ½ tbsp. butter	3	
1 cup coffee		
1 tbsp. sugar and 1 tbsp. cream		
	3	243
DINNER:		
4 tbsp. string beans	1	
Medium sized tomato and lettuce	2	
Salad with mineral oil mayonnaise or vinegar		
1 corn muffin, cooled or 1 average slice bread	3	
½ recipe of apple tapioca pudding with 2 tbsp. cream	1	
1 tbsp. butter		
1 glass milk	7	
	14	609
SUPPER:		
6 tbsp. cream of wheat with butter	2	
3 tbsp. buttered carrots	1	
Pineapple and marshmallow salad with cream dressing		
1 slice whole wheat bread	4	
½ tbsp. butter		
1 glass milk	7	
	14	724
Total	31	1,576

* No salt; unsalted butter.

Monday

	Protein	Calories
Breakfast:		
½ grapefruit		
1 medium slice whole wheat bread toasted if desired	4	
1 heaping tbsp. orange marmalade		
½ tbsp. butter (sweet)		
Cup coffee; 1 tbsp. cream		
1 glass milk	7	
2 tsp. sugar		
	11	570
Dinner:		
1 tbsp. sweet butter		
1 medium tomato stuffed with celery	2	
baked and served with 1 strip crisp unsalted bacon	2	
Average helping buttered cauliflower	1	
Stuffed date salad (use 4 dates and 2 walnuts) with ½ of cream dressing recipe	2	
1 whole wheat muffin cooled	4	
Baked banana with 1 tsp. sugar and lemon juice	1	
	12	550
Supper:		
2 heaping tbsp. scalloped corn	3	
2 heaping tbsp. squash	1	
Medium sized lettuce and tomato salad with vinegar or mineral oil mayonnaise	1	
1 bran muffin	2	
1 cup tea with 2 tsp. sugar		
1 tbsp. sweet butter		
1 glass milk	7	
	14	560
Total	37	1,680

TUESDAY

	Protein	Calories
BREAKFAST:		
½ average sized orange or 4 tbsp. strawberries		
2 heaping tablespoonfuls oatmeal	3	
4 tbsp. M. cream	2	
3 tsp. sugar		
1 glass milk	7	
1 cup coffee		
	12	423
DINNER:		
8 tbsp. cream of tomato soup	3	
4 slices parsnips with butter		
Salad 2 heaping tablespoonfuls chipped cabbage, mixed with 1 tsp. fine cut green pepper and onion juice and ½ tbsp. regular mayonnaise		
1 corn muffin cooled, or 1 slice bread	3	
Apple tapioca pudding with 2 tbsp. heavy cream	1	
	7	778
SUPPER:		
2 heaping tbsp. macaroni cooked with tomatoes	3	
2 heaping tbsp. squash	1	
2 heaping tablespoonfuls beet greens	2	
3 stalks celery		
½ average slice bread	2	
1 tbsp. sweet butter		
1 glass milk	7	
	15	459
Total	34	1,660

Wednesday

	Protein	Calories
Breakfast:		
Small bunch grapes	1	
1 bran muffin, cooled	2	
½ tbsp. sweet butter		
1 h. tbsp. orange marmalade		
1 glass milk	7	
1 cup coffee		
	10	427
Dinner:		
Medium baked potato	4	
Average helping boiled onion, buttered	1	
Average helping greens or cabbage	1	
2 tbsp. carrots mixed with green pepper and bit of onion; mix with ½ tbsp. regular mayonnaise and serve as salad on lettuce		
1 corn muffin cooled or 1 slice bread	3	
1 large baked banana with 1 tsp. sugar and lemon	1	
	10	761
Supper:		
8 tbsp. cream of celery soup	3	
Small lettuce salad—3 or 4 leaves—with vinegar		
½ slice whole wheat bread	2	
1 tbsp. sweet butter		
Pineapple sauce (1 slice canned)		
1 glass of milk	7	
	12	512
Total	32	1,690

THURSDAY

	Protein	Calories
BREAKFAST:		
Small baked apple		
3 heaping tbsp. oatmeal	4	
1 average slice toast	3	
1 tbsp. sweet butter		
4 tbsp. M. cream	2	
3 tsp. sugar		
1 cup coffee		
	9	591
DINNER:		
2 h. tbsp. spinach served with ½ boiled egg and ½ slice toast cut in strips	7	
2 heaping tbsp. mashed turnips		
Average sized tomato salad with vinegar	2	
Pineapple delicious—1 slice pineapple cut small with 2 marshmallows		
1 tbsp. sweet butter		
1 glass milk	7	
	16	495
SUPPER:		
2 tbsp. creamed potatoes	2	
1 large broiled tomato	3	
Fruit salad ½ each of canned peach and pear salad with cream dressing		
Bran muffin cooled	2	
	7	546
Total	32	1,632

CHRONIC NEPHRITIS WITH EDEMA

Recognition of this form of nephritis is not always simple, for an edematous patient who has albumen in his urine does not necessarily have nephritis. Christian suggests that the response of the patient to digitalis or to diuretin offers a good means of differentiating nephritic from cardiac edema. If the edema is of cardiovascular origin, either of these drugs will usually produce diuresis; but if the kidney is primarily at fault, a diuretic response is unlikely.

This disease may be regarded as a form of subacute nephritis. The salient feature in its disturbed physiology is retention of water and sodium chloride. As a rule, nitrogen retention is not great, and the circulatory system, at least in the beginning, remains intact. Edema is a marked and constant symptom. The urine contains an abundance of albumen and casts. The oliguria indicates the difficulty with which the kidney excretes water.

This difficulty in water and mineral excretion suggests the type of diet which is most suitable—one which contains little fluid and a minimum of mineral elements. It is the same type of diet which has been recommended for the second and subsequent weeks of acute nephritis, except perhaps that the protein allowance should be a little more liberal and the mineral intake a little more restricted. The usual chloride content of the "salt-poor" diet (about 2 Gm.) may be restricted still further by prescribing for a time salt-free bread and foods of very low salt content. The total fluid intake for the adult as a rule should be limited to from 800 to 1,000 cc.

A good example of this type of dietary regimen is that devised by Keith and his co-workers[16] at the Mayo Clinic. They emphasize the fact that both the water content and the mineral quota of the food should be subject to exact control. They found that the foods provided in their routine "salt-poor" diets contained too much water, from 1,200 to 1,400 cc., and that this when added to that taken as fluid brought the actual daily intake of fluids up to from 1,800 to 2,400 cc. In revising this diet, their effort has been "(1) to decrease the water contained; (2) to reduce the amount of sodium, since sodium retention has been shown to be associated with water retention, and (3) so to control the diet that this minimal content of water would be, for practical purposes, the same from day to day."

The patient as treated by these authors is first put on a diet sufficient to meet his estimated basal metabolic requirements, say 1,500 calories with 40 Gm. of protein. For such a diet food is selected which is low both in water and in mineral content. The food should contain not more than 880 Gm. of water. It is not difficult in the foods selected to hold down the mineral content, but it is desirable to substitute rice and macaroni for potato because of the high potassium content of the latter. Six-hundred grams of fruits and vegetables are given, of which at least 400 Gm. is in the form of fresh fruits and green vegetables. Orange, grapefruit, banana, lettuce, tomato and string beans are suitable. Canned tomatoes and canned string beans of any standard brand may be used. In the preparation and serving of the food no salt is added. From 800 to 1,000 cc. of fluid is permitted, which with the water of the food provides a daily intake of water from 1,400 to 1,600 cc.

Subsequently, when the patient's metabolic requirement and his ability to take care of protein is more accurately known, the diet is increased. This increase is largely in the form of protein and total calories, with little increment in the water and mineral content. The standard diets reach a protein content of 50 Gm. with a caloric value of 2,500. The composition of the standard diets of Keith and his associates and a sample menu are given below.

These authors have used these diets with satisfactory results for the relief not only of nephritic edema, but of other forms of edema also. They report that the mineral deprivation of this regimen continued in some cases as long as three months, in their experience has not produced any ill effects. The mineral content of the commoner foods will be found in the section on Mineral Requirement, Chapter III.

Table 1.—*Composition of the Diet* (*Keith*)

Diet	Carbohydrate, Gm.	Protein, Gm.	Fat, Gm.	Calories	Water, Cc.	Sodium, Gm.	Potassium, Gm.	Calcium, Gm.	Magnesium, Gm.	Chlorine, Gm.	Phosphorus, Gm.	Sulphur, Gm.	Iron, Gm.
1	189	37	65	1,531	1,286	1.156	3.745	0.807	0.312	1.585	0.991	0.736	0.013
2	148	40	80	1,515	809	0.507	1.625	0.225	0.196	0.668	0.657	0.562	0.009
3	243	40	92	2,016	834	0.528	1.637	0.328	0.212	0.693	0.666	0.569	0.009
4	175	50	126	2,094	872	0.747	1.772	0.292	0.208	0.867	0.741	0.692	0.011
5	235	50	144	2,508	895	0.770	1.872	0.307	0.223	0.888	0.751	0.700	0.011

Table 2.—*Weighed Low Salt, Low Fluid Diet* (*Diet 2, Table* 1) (*Keith*)

Breakfast	Gm.	Dinner	Gm.	Supper	Gm.
Ten per cent fruit	100	Five per cent vegetable	100	Five per cent vegetable	100
Eggs (one)		Rice	100	Macaroni	100
Toast	20	Banana	100	Fifteen per cent fruit	100
Butter	10	Meat	45	Ten per cent fruit	100
Sugar	5	Mayonnaise	15	Bread	20
		Bread	20	Butter	15
		Butter	15	Eggs (one)	
		Sugar	5	Mayonnaise	15
				Sugar	5

MENUS WHICH THE AUTHOR HAS FOUND USEFUL FOR PATIENTS HAVING CHRONIC NEPHRITIS WITH EDEMA*

Sunday

Breakfast:
½ glass orange juice
1 soft boiled egg
1 medium sized slice toast with 1 tsp. sweet butter
10 a. m.: 1 medium sized baked apple with 2 tbsp. whipped cream
Dinner:
1 lean lamb chop
2 heaping tbsp. rice
2 tsp. sweet butter
3 h. tbsp. carrots; ½ tbsp. butter
1 medium sized tomato salad; 1 tbsp. unsalted mayonnaise
1 corn muffin or 2 slices unsalted bread with
½ tbsp. sweet butter
½ cup fruit ice
4 p. m.: 1 baked banana with 1 tsp. sugar and lemon juice
Supper:
Spinach with 1 egg yolk and ½ slice toast
1 baked stuffed (with celery and bread crumbs) tomato
Average helping apple-celery salad with 1 tbsp. mayonnaise, unsalted
⅔ cup creamed tapioca
1 slice whole wheat bread
½ tbsp. unsalted butter

	Protein	Calories
Total	44	1,826

Monday

Breakfast:
Dish of prunes (4 large) with juice
2 heaping tbsp. farina with 1 tbsp. sugar and 1 tsp. butter
4 tbsp. cream
1 slice toast with 1 tsp. butter and 1 heaping tsp. jam
Dinner:
1 small helping baked fish with tomato sauce
3 heaping tbsp. creamed cauliflower
2 heaping tbsp. hot buttered beets
½ tbsp. unsalted butter
1 cooled corn or flour unsalted muffin with ½ tbsp. unsalted butter
Small serving lettuce with 1½ tbsp. French dressing
1 medium baked banana with 1 tsp. sugar and lemon juice
Supper:
1 shirred egg
Average helping baked spaghetti and tomato
Average helping creamed cabbage
1 tbsp. fruit salad with cream dressing
1 slice whole wheat bread, ½ tbsp. unsalted butter
½ peach (canned) with juice

	Protein	Calories
Total	44	1,975

* Add no salt to food after it comes to the table.

TUESDAY

BREAKFAST:

- ½ grapefruit
- 2 h. tbsp. oatmeal eaten with ½ tbsp. unsalted butter (cream and sugar may be added instead of butter)
- 1 egg on toast; 1 tsp. butter

10 a. m : 1 medium baked apple; 2 tsp. sugar with 2 tbsp. whipped cream

DINNER:

- 1 heaping tbsp. baked macaroni and cheese
- 1 medium stuffed baked tomato
- 2 heaping tbsp. spinach; 1 slice bread; ½ tbsp. unsalted butter
- Orange and date (1 orange and 4 dates) salad with 1 tbsp. cream dressing

4 p. m.: ½ glass grape or 1 cup orange juice

SUPPER:

- ⅓ cup of creamed dried beef on toast
- 2 heaping tbsp. hot grits with ½ tbsp. unsalted butter
- 3 heaping tbsp. buttered carrots; 1 tsp. butter
- Lettuce salad with 1 tbsp. Thousand Island dressing; no salt
- 1 slice whole wheat bread with ½ tbsp. butter

BEDTIME:

- ½ glass orange juice

	Protein	Calories
Total	46	2,050

WEDNESDAY

BREAKFAST:

- 1 m. s. baked apple with 1 tbsp. whipped cream
- 2 heaping tbsp. cream of wheat with ½ tbsp. butter
- 1 bran muffin cooled, with ½ tbsp. butter
- 1 h. tbsp. marmalade

10 a. m.: ½ glass orange juice

DINNER:

- 1 small serving white meat of chicken
- 2 tbsp. rice with ½ tbsp. butter
- 4 heaping tbsp. string beans; 1 tsp. butter
- Spinach salad (3 tbsp. put in mold and on ice; serve on lettuce with 1 tbsp. mayonnaise)
- 1 corn or whole wheat muffin, cooled with ½ tbsp. butter
- 2 heaping tbsp. prune pulp with 1 tbsp. whipped cream

4 p. m.: 1 small raw apple

SUPPER:

- 1 egg omelet with 1 medium broiled tomato; 1 tsp. butter
- 2 heaping tbsp. squash or average helping buttered onion
- 1 slice bread toasted; ½ tbsp. butter
- 2 heaping tbsp. apple tapioca pudding
- Lettuce salad with 1 tbsp. French dressing

	Protein	Calories
Total	46	2,080

THURSDAY

BREAKFAST:
1 heaping tbsp. apple sauce
1 slice cream toast soaked with 1 slice crisp bacon
1 soft boiled egg
10 a. m.: ½ glass orange juice

DINNER:
6 panned oysters on toast; 1 tsp. butter
3 h. tbsp. vegetables; peas (2) and carrots (1) with 1 tsp. butter
3 heaping tbsp. baked spaghetti with tomato
1 h. tbsp. chocolate pudding with 2 tbsp. cream
Small tomato salad with 1 tbsp. mayonnaise
4 p. m.: 2 h. tbsp. stewed tomatoes

SUPPER:
1 poached egg on 2 heaping tbsp. hot grits
1½ tbsp. butter
2 heaping tbsp. spinach
1 slice bread and ½ tbsp. butter
½ cup fruit sherbet
Lettuce salad with 1 tbsp. Thousand Island dressing

	Protein	Calories
Total	47	1,831

Nephrosis.—A radically different diet has been devised by Epstein.[9] He draws a distinction between parenchymatous nephritis in which the glomeruli are involved and "nephrosis" in which tubular degeneration predominates. He believes that this disease begins as a metabolic disorder which leads, first to albuminuria (diabetes albuminuricus) and, second, to changes in the kidneys. He regards as the primary fundamental change an increase in the blood lipoids and as secondary to this a reduction of the protein of the blood serum and change in the ratio of albumen to globulin. He thinks with Eppinger that the thyroid gland bears some relation to this disease, and he has used thyroid substance with satisfactory results.

Diet employed by Epstein:

Food value	1,280 to 2,500 calories.
Protein	120 to 240 Gm.
Fat (unavoidable)	20 to 40 Gm.
Carbohydrate	150 to 300 Gm.

The following articles of food are used:

Lean veal, lean ham, whites of eggs, oysters, gelatin, lima beans, lentils, split peas, green peas, mushrooms, rice, oatmeal, bananas, skim milk, coffee, tea and cocoa.

The fluid is restricted to the quantity present in the food plus that which is necessary for the patient's comfort, as a rule from 1,200 to 1,500 cc. Enough salt is permitted to make the food agreeable.

Comment.—When the figures for blood urea and nonprotein nitrogen are within normal limits, it is justifiable to try this high protein diet;

for such a diet for a limited period in these cases will do no harm. It is true that occasionally we encounter patients who have chronic nephritis with edema who improve when they are allowed more protein; but American clinicians as a rule do not agree that this is a frequent occurrence, or that the condition described by Epstein constitutes a disease sui generis.

SPECIMEN HIGH PROTEIN DIETS

SUNDAY

	Carbohydrate	Protein	Fat	Calories
BREAKFAST:				
½ Cantaloupe or 1 medium orange	21	1		
2 heaping tbsp. farina with ½ glass skimmed milk	17	6		
12 panned oysters and 2 strips crisp bacon on 2 medium slices of toast	18	16	12	
1 cup coffee with 2 tsp. sugar	20			
	76	23	12	504
DINNER:				
Cup canned mock turtle soup with 2 Uneeda biscuits	6	6	1	
Roast chicken, average helping	..	32	4	
1 ear or 2 heaping tbsp. corn	19	3	1	
2 h. tbsp. lima beans	24	6	1	
Spinach salad with ½ hard boiled egg and mineral oil mayonnaise	3	6	7	
4 h. tbsp. snow pudding	23	9		
1 average sized slice whole wheat bread	21	4		
½ cup black coffee or tea with one tsp. sugar	10			
	106	66	14	814
SUPPER:				
A. h. sweet bread or brains scrambled with 1 egg	..	38	6	
1 teaspoonful butter	..	..	4	
1 medium baked potato	32	4		
3 h. tbsp. green peas	13	6		
A. h. lobster salad with mineral oil mayonnaise	..	17	2	
1 a. s. slice whole wheat bread	21	4		
2 h. tbsp. apple tapioca pudding	22			
Cup tea with 1 tsp. sugar	10			
	98	69	12	776
Total	280	158	38	2,094

MONDAY

	Carbo-hydrate	Protein	Fat	Calories
BREAKFAST:				
½ medium grapefruit	20	1	1	
A. h. broiled mackerel with	..	22	5	
A. h. sweetbreads or brains	..	32		
Lemon				
1 bran muffin	8	2	2	
1 cup coffee with 2 tsp. sugar	20			
	48	57	8	
DINNER:				
½ dozen oysters on half shell with lemon	3	5	1	
Large helping turkey white meat	..	35	5	
M. s. baked potato	32	4		
3 h. tbsp. green peas	13	6	3	
A. h. lettuce salad with vinegar	2			
Fruit cup, ½ each orange and grapefruit, and 2 lady fingers	38	3	2	
1 a. s. slice whole wheat bread	20	4		
½ cup black coffee				
	108	57	11	
SUPPER:				
Small cup home made chicken soup with 2 Uneeda biscuits	6	14	1	
A. h. broiled tenderloin steak—	..	24	1	
no fat—served with 6 panned oysters	3	5	1	
1 teaspoonful butter	..	..	4	
2 h. tbsp. lima beans	23	6	1	
1 a. s. slice bread whole wheat	20	4		
1 baked banana with lemon juice	32	2	1	
and 1 tsp. sugar	10			
Cup tea with lemon and 2 tsp. sugar	20			
	114	55	9	
Total	270	169	28	2,008

TUESDAY

	Carbohydrate	Protein	Fat	Calories
BREAKFAST:				
1 large baked apple	29	1		
2 h. tbsp. grapenuts with ½ glass skimmed milk	26	7		
2 poached eggs on medium slice toast	12	18	12	
1 cup coffee with 2 tsp. sugar	20			
	87	26	12	
DINNER:				
Fruit cup ½ each orange and grapefruit	10			
A. h. roast beef with mushroom sauce		23	1	
1 h. tbsp. mashed potatoes	9	1	2	
2 h. tbsp. spinach with 1 hard boiled egg	3	9	10	
M. s. tomato salad with vinegar	8	3		
1 corn muffin or 1 a. s. slice bread	18	3		
2 h. tbsp. Spanish cream (no. 2)	21	12	7	
Cup tea with 2 tsp. sugar and lemon if desired	20			
	89	51	20	
SUPPER:				
Twice a. h. broiled sweet breads with homemade tomato sauce	..	64		
1 tsp. butter	..	..	4	
2 h. tbsp. lima beans	24	6	1	
Pineapple salad, 1 slice with mineral oil mayonnaise	18	..	2	
2 bran muffins	16	3	4	
2 graham crackers	11	2	1	
Cup tea with 2 tsp. sugar and lemon	20			
	89	75	12	
Total	265	152	44	2,064

CHRONIC NEPHRITIS WITHOUT EDEMA

This is a disease of long duration, usually of years, and therefore in planning the patient's dietary, the endeavor should be not only to spare the kidney, but also to provide a ration which will keep him in the highest degree of vigor for the longest period of years. To accomplish this, the food must be adequate in kind and in amount.

It should be borne in mind, too, that this is not a disease of the kidney alone—that the heart and arteries eventually become involved and that still other organs often become impaired. In the last analysis, the fate of the patient usually depends on the efficiency of his heart and the integrity of his arteries. The influence on these organs of rigid dietary restriction carried out through a period of years must always be considered. We have no reliable information of the effect of such a diet long continued. Chittenden's relatively brief observations on groups of young men suggested to him that rigid dietary restriction, particularly as to protein, was well borne; but McCollum's experiments with mice (see Chapter III) would indicate that curtailment of protein intake through an appreciable part of the animal's span of life will result in a loss of vigor and premature deterioration. The application to man of McCollum's observations must be kept in mind when prescribing a diet for the patient with chronic nephritis.

The caloric intake should be small but sufficient to meet the patient's needs. The thin person's weight (and vigor) should be maintained. The obese patient should be encouraged to lose a little weight gradually, say at the rate of from 3 to 5 pounds each month, until the ideal weight is approached. Such reduction in weight not only lowers metabolism, but it also lessens the burden on the heart. Patients who lead sedentary lives should take more exercise of the right kind (golf and walking) and those who are accustomed to violent exercise should curtail their activity. Roughly, the man of sedentary habits can usually get along on 2,000 calories daily. If he plays nine holes of golf twice weekly or takes a short walk daily, he should be allowed 2,500 calories. Gain or loss in weight is the best criterion of the adequacy of his diet. The patient of normal (or subnormal) weight should be told to add to his allowance if he finds that he is losing weight. A more complete statement of man's caloric needs when engaged in various forms of activity will be found in Chapter III.

Attention is always focused, sometimes with too much intensity, on the protein quota. The protein intake must be restricted, but to tell the patient with mild or even moderately severe chronic nephritis, as is often done, that he must eat no meat and no eggs, is perhaps to do him a real injury. He should receive sufficient protein to meet his minimal needs, otherwise he will suffer. In mild cases with little impairment of renal efficiency, from 60 to 75 Gm. of protein daily may be allowed; in moderately severe cases, from 40 to 50 Gm.; while in the gravest cases with high blood urea and signs of impending disaster, the daily protein intake should for a time be limited to about 25 Gm. For the patient with mild to moderately severe chronic nephritis, the following protein allowance is appropriate: in addition to three glasses of milk and one egg daily, he may take three days weekly (or perhaps four) one average helping of meat or fish. It is well to emphasize that there is no difference, as far as his kidneys are concerned, between red and white meat, and that gram for gram he can take beefsteak with the same impunity with which he can eat breast of chicken.[17]

The degree of salt restriction should depend on the ability of the kidneys to excrete salt. The average diet as it comes to the table without the addition of salt, provided the butter is unsalted and there are included no unusually salty articles, carries the equivalent of about 2 Gm. of sodium chloride. This constitutes the "salt-poor" diet and represents the proper degree of chloride restriction. The "salt-free" diet (about 0.5 Gm.) used by Allen is unnecessarily rigid. In fact, in mild cases with no tendency toward edema, the patient himself may perhaps be permitted to add a little salt at the table, say 2 Gm. daily (always weighed). As a rule, however, the "salt-poor" diet is advisable.

This diet has the disadvantage that it is lacking in flavor and is likely to pall on the patient. This can in part be overcome by arranging a wide variety of foods and allowing the patient as far as is consistent the foods he likes. The addition of onion and other foods with distinctive flavor will sometimes lend a little zest and make up for the lack of salt. A little sugar cooked with unsalted vegetables will make them more palatable.

A wide latitude should be permitted in the further arrangement of the diet. Carbohydrates should furnish more than half the total calories. A part of the fat should be in the form of butter and cream; the butter should be unsalted. Milk should always be included. An abundance of vegetables and fruits should be included—both because of the vitamins which they contain and because of their mineral content and base-forming properties. Alcohol and all condiments should be absolutely interdicted. Tea and coffee should be reduced to the minimum, one cup daily; it is better to omit these beverages altogether. In order to throw the least possible burden on the digestion and to assure the maximum of assimilation, the food should be simple and easily digested. Fried foods and pastries, unless especially well prepared, should be forbidden; this applies also to complex "made" dishes, such as croquettes, and to all peppery, piquant foods.

MENUS FOR PATIENTS WITH CHRONIC NEPHRITIS WITHOUT EDEMA*

SUNDAY

	Protein	Calories
BREAKFAST:		
½ orange		
2 heaping tbsp. grapenuts with ½ glass milk	7	
1 shirred egg	7	
1 slice whole wheat bread toasted if desired	4	
1 cup coffee with 1 tsp. sugar and 1 tbsp. cream (A)	1	
	19	488
DINNER:		
Small helping broiled tenderloin steak	14	
2 heaping tbsp. greens of any kind	2	
1 ear corn or 2 h. tbsp	3	
Average helping lettuce and tomato salad with vinegar or mineral oil mayonnaise		
1 corn muffin or 1 average slice bread	3	
4 tbsp. soft custard	4	
1 glass milk	7	
	33	780
SUPPER:		
1 egg scrambled and served with 1 medium sized broiled tomato	9	
3 h. tbsp. carrots with ½ tsp. butter		
Pineapple salad (1 slice), canned, with cream dressing	1	
1 bran muffin toasted	2	
1 graham cracker	1	
1 glass milk	7	
	20	677
Total	72	1,945

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* Very little salt; butter unsalted.

Monday

	Protein	Calories
Breakfast:		
½ cantaloupe or m. s. orange	1	
2 heaping tbsp. oatmeal	2	
with 2 tsp. sugar and 2 tbsp. cream	1	
1 soft boiled egg	7	
1 slice toast, medium	1	
1 cup coffee with 1 tsp. sugar and 1 tbsp. cream		
	12	563
Dinner:		
Small helping roast beef; no gravy or fat	14	
Small baked potato with 1 tsp. butter	2	
Average helping string beans		
M. s. tomato and lettuce salad with vinegar or mineral oil mayonnaise	2	
1 corn muffin or 1 slice whole wheat bread	4	
Apple whip made with 1 tbsp. apple sauce and 1 tbsp. whipped cream	1	
1 glass milk	7	
	30	620
Supper:		
Small serving creamed sweetbreads (3 tbsp. cream sauce)	16	
2 heaping tbsp. stewed celery or okra	2	
A. h. lettuce salad with vinegar		
1 bran muffin; 1 tsp. butter	2	
Small sized baked apple with 2 tbsp. cream	1	
1 glass milk	7	
	28	703
Total	70	1,886

Tuesday

	Protein	Calories
Breakfast:		
A. s. peach or 4 heaping tbsp. strawberries	1	
2 heaping tbsp. Force or corn flakes with 2 tsp. sugar and ¼ glass milk	2	
Shirred egg	7	
1 bran muffin with 1 tsp. butter	2	
Coffee with 2 tsp. sugar and 2 tbsp. cream	2	
	14	598
Dinner:		
A. h. broiled trout or small serving roast lamb, no fat	11	
S. s. baked potato	2	
2 h. tbsp. spinach	2	
M. s. tomato and lettuce salad with vinegar or mineral mayonnaise	2	
1 corn muffin or average slice bread	3	
1 tsp. butter		
1 h. tbsp. snow pudding	2	
1 glass milk	7	
	29	571
Supper:		
10 oysters panned	9	
on large slice toast; 2 tsp. butter	2	
2 heaping tbsp. string beans or greens	1	
Orange salad (1 orange sliced) with cream dressing		
1 a. s. slice whole wheat bread	4	
1 glass milk	7	
	23	656
Total	66	1,825

ARTERIAL HYPERTENSION

Vascular hypertension could with equal propriety be discussed here or with diseases of the circulatory system; custom, as well as convenience, suggests that it be considered here.

Does high blood pressure constitute a disease entity or is it a symptom of several disease states? In its origin, is it metabolic, degenerative or perhaps infectious? What relation does it bear to nephritis? Is the one dependent on the other or both on a common cause? What relation does it bear to arteriosclerosis; assuredly they are related, but which comes first? These questions and many more suggest themselves. For our present purposes, we must regard hypertension merely as a disease complex, the exact pathogenesis of which is unknown, but which in its later stages is accompanied by disease of the kidneys, of the myocardium and usually of the arteries.

Attempts have been made to differentiate types and to adjust the diet accordingly. There is the obese woman, robust in appearance, who has borne several children, and who without many symptoms or much discomfort, at or about the menopause develops hypertension; there is another type of patient of about the same age, sometimes very thin, who complains of cardiac palpitation and of various nervous troubles. The tense, highly neurotic person, sometimes overweight, sometimes thin, constitutes a special problem; it is a question whether emotional instability is the sequel or the cause of the hypertension. The best example of this type is the man who lives under high tension, is intense in his feelings and in meeting his problems, is often irritable, who never takes a vacation and who never gets a chance to relax. One cannot help but feel that this psychic state endured through a period of years must in some way be responsible for changes which lead up to arterial hypertension. Then there is the fulminant type, as exemplified by the relatively youthful person, usually under 45, who suddenly shows marked hypertension. He complains of headache and sometimes of insomnia. At first there may be no recognizable renal disturbance, but a little later marked kidney impairment appears. The disease pursues a rapidly fatal course, and usually the patient dies in coma within eighteen months or two years. I have been impressed by the malignancy of this type of hypertension; while renal impairment is prominent toward the end, I am sure it is not the ultimate cause of this disease.

Many patients with hypertension show no symptoms. Others have attacks of dizziness, ringing in the ears, shortness of breath on exertion, tachycardia, irritability and insomnia; they are easily fatigued, and may have all manner of gastro-intestinal symptoms.

In arranging the diet, the effort should be to spare both the heart and the kidneys. Since we do not know the underlying cause of arterial hypertension or to just what extent in its early stages the kidneys are impaired, it is difficult to determine how far we should restrict the consumption of protein and salt. I am sure much harm has been done to patients with little if any renal impairment through unnecessarily drastic protein restriction. It must be admitted that the eating of too much protein can cause harm—sometimes disaster—and that the patient with arterial hypertension should never be permitted an excessive protein intake. On the other hand, if his kidney function is good, as evidenced by an approximately normal urine and normal blood chemistry, and there is little or no increase in night urine and no fixation of specific gravity, he should be allowed a sufficient amount of protein to meet his needs—for the average man, about 75

Gm. daily. If there is kidney impairment, this amount should be reduced somewhat, to 60 or perhaps 50 Gm.

Salt restriction is always advisable in arterial hypertension—not, I believe, to the extent insisted on by Allen in his "salt-free" diet (about 0.5 Gm. daily), but rather to the limits of the salt-poor diet ordinarily used (about 2 Gm.)—the type of restriction advised in chronic nephritis (page 462). I doubt whether salt restriction beyond this point ever accomplishes anything.

No foods should be permitted which have an unduly stimulating or irritating effect on the nervous system. Alcohol should be entirely prohibited. It is best for these patients to take no coffee, tea or other caffeine-containing drinks. However, comfort and contentment play a rôle, and if it is essential to the patient's comfort and happiness that he have his morning cup of coffee, I think it should be allowed. One cup, however, should be the limit.

In other respects the patient may be permitted a fairly liberal diet with a wide lattitude of choice. It is essential that his weight be kept within reasonable bounds; if he is obese, he should gradually reduce at the rate of about 5 pounds a month until his normal figure is reached. By giving a slightly subcalorie diet, combined with rest, the metabolic rate can be materially reduced and the work of the various organs thus lessened. It should be borne in mind, however, that this is usually a disease of many years' duration, and that the subcalorie diet should not be too far below the patient's metabolic needs—not more, say, than 10 or 15 per cent. Even then, this diet should be based somewhat on its influence on his vigor and sense of well-being. The diets advised above for patients who have chronic nephritis without edema are, with the explanations just noted, suitable for those with arterial hypertension. Each patient's case constitutes a separate problem, and these diets must be rearranged to meet individual needs.

Water balance in arterial hypertension has in the past received considerable discussion because it was once thought that rigid restriction of fluids would lower blood pressure. It is possible that the drinking of excessively large quantities of water may do some harm. It seems best, therefore, to permit the patient a moderate amount of fluid—such an amount as his appetite and thirst demands—provided, of course, that his appetite is not grossly abnormal. From 1,500 to 2,000 cc. of total fluids is probably appropriate for the average adult; in summer, and especially in warm climates, this may be increased.

The fulminant, rapidly fatal hypertension which sometimes is seen in youthful persons deserves separate consideration. It may run a course of less than a year; I have seen patients of this type die within a few months after the first symptoms were noted. Renal impairment is not necessarily an early feature; but later it may dominate the picture. Although myocardial failure sometimes carries him away, the patient usually dies from uremia. Rigid dietary restriction, in addition to absolute rest in bed, accomplishes something; just how much, it is difficult to say. For the first four or five days, the food should consist only of 1 quart of milk daily with fruit juices; then for another four weeks, there should be a subcalorie diet in which the bulk of the energy is in the form of carbohydrate—toast, preserves, cereals, etc.—with a continued low protein intake, say from 30 to 40 Gm. daily. After this a normal liberal diet approaching somewhat the menus given on page 463, should be observed. Each patient must be treated individually; the more ominous the symptoms, the more rigid the diet.

The following menus are specimens of those used by the author.

SPECIMEN DIETS FOR PATIENTS WITH ARTERIAL HYPERTENSION

Add little or no salt to the food after it comes to the table

	Protein	Calories
Breakfast:		
1 sliced orange		
4 h. tbsp. Farina	3	
1 whole wheat muffin, cooled	4	
1 tsp. washed butter		
4 tbsp. cream	2	
4 tsp. sugar—1 cup coffee		
	9	661
Dinner:		
1 small sized baked potato	2	
Average helping fresh turnip greens or cabbage		
Medium sized tomato and lettuce salad with ½ tbsp. mayonnaise	2	
1 corn muffin, cooled	3	
Baked egg custard	7	
1 tbsp. washed butter		
1 gl. butter milk	6	
	20	850
Supper:		
4 h. tbsp. creamed potatoes	4	
2 h. tbsp. spinach or beet greens	2	
Fruit salad (½ each grapefruit and orange and 2 strawberries with cream dressing)		
1 bran muffin	2	
½ tbsp. butter, washed		
1 gl. milk	7	
	15	704
Total	44	2,215

Specimen Diet 2

	Protein	Calories
BREAKFAST:		
4 stewed prunes	1	
2 h. tbsp. oatmeal	3	
1 whole wheat muffin cooled	4	
½ tbsp. washed butter		
4 tbsp. cream; 4 tsp. sugar	2	
1 cup coffee		
	10	778
DINNER:		
2 h. tbsp. baked macaroni with tomato or 1 small baked potato	3	
2 tbsp. creamed cauliflower with 2 tbsp. cream sauce	3	
Pineapple (1 slice) and nut (2 walnuts) salad with ½ tbsp. mayonnaise	2	
1 slice bread	3	
Spanish cream, ½ of recipe	6	
1 glass milk		
½ tbsp. butter		
	17	948
SUPPER:		
2 h. tbsp. hominy with butter	2	
2 h. tbsp. spinach	2	
Tomato stuffed with celery and baked	2	
String beans, 3 tbsp	2	
Date salad—6 dates with 3 marshmallows—and lettuce with cream dressing	1	
1 slice bread	3	
1 glass butter milk	7	
	19	665
Total	46	2,391

Specimen Diet 3

	Protein	Calories
BREAKFAST:		
Small baked apple		
5 h. tbsp. corn flakes with ½ glass milk	6	
1 small slice toast	1	
2 strips unsalted crisp bacon	4	
Sugar 5 tsp		
½ tbsp. butter		
Cup coffee with 2 tbsp. cream	1	
	12	668
DINNER:		
1 small baked potato	2	
3 heaping tbsp. spinach or beet greens	2	
Large tomato salad with ½ tbsp. regular mayonnaise	3	
1 corn muffin or average slice bread	3	
2 h. tbsp. orange ice	1	
1 glass milk	7	
	18	1,033
SUPPER:		
1 slice creamed toast—3 tbsp. cream sauce—served	5	
3 h. tbsp. buttered carrots	1	
Spinach salad with ½ hard boiled egg and ½ tbsp. mayonnaise	6	
Apple whip ½ of recipe		
1 glass milk	7	679
Total	19	2,380

Specimen Diet 4

	Protein	Calories
Breakfast:		
1 fresh peach, strawberries or 2 slices fresh pineapple	1	
3 tbsp. oatmeal	4	
Poached egg on toast	9	
½ tbsp. butter; 4 tbsp. cream	3	
5 tsp. sugar		
Cup coffee		
	17	793
Dinner:		
A. h. roast lamb, 1 slice, with mint sauce	15	
2 h. tbsp. mashed potatoes	3	
3 tbsp. buttered cauliflower	1	
A. h. lettuce with vinegar or lemon juice		
1 French roll or slice bread	3	
Spanish cream no. 1	8	
Butter, 1 tbsp		
1 glass milk	7	
	37	960
Supper:		
6 panned oysters on a slice toast	8	
2 h. tbsp. greens or beans	2	
Fruit salad (½ each canned peach and pear) with creamed dressing	1	
3 stalks celery	0	
4 tbsp. soft custard	4	
1 gl. butter milk; ½ tbsp. butter	6	
	21	646
Total	75	2,399

Specimen Diet 5

	Protein	Calories
Breakfast:		
4 h. tbsp. strawberries or		
½ a. s. orange	1	
2 h. tbsp. H. O. or oatmeal	2	
2 slices crisp bacon	3	
1 whole wheat muffin, cooled	3	
½ tbsp. butter		
4 tbsp. cream	3	
Coffee with 5 tsp. sugar		
	12	788
Dinner:		
A. h. broiled mackerel or large serving trout with lemon	12	
Small sized baked potato	2	
2 h. tbsp. greens	2	
Average serving tomato salad with lettuce and ½ tbsp. mayonnaise	2	
1 corn muffin or average sized slice bread	3	
Orange ice, 2 h. tbsp	1	
1 glass milk	7	
1 tbsp. butter		
	29	1,018
Supper:		
Shirred egg	7	
2 h. tbsp. baked macaroni with tomatoes	3	
3 h. tbsp. buttered carrots	1	
Spinach salad with ½ tbsp. mayonnaise	2	
1 a. s. slice bread	3	
1 tbsp. butter		
Peach sauce (½ slice)		
1 glass butter milk	6	
	22	606
Total	63	2,412

Specimen Diet 6

	Protein	Calories
BREAKFAST:		
½ grapefruit		
Poached egg on toasted buttered shredded wheat and 2 slices thin crisp bacon	13	
½ tbsp. butter		
3 tsp. sugar		
Coffee with 2 tbsp. heavy cream	1	
	14	670
DINNER:		
M. helping roast chicken	25	
1 heaping tbsp. rice with butter	3	
2 heaping tbsp. cauliflower with butter	1	
2 heaping tbsp. squash	1	
A. h. lettuce with vinegar		
3 small stalks celery and 3 green olives	1	
Apple tapioca with 1 tbsp. whipped cream	1	
1 a. s. slice bread or muffin	3	
1 glass milk	7	
1 tbsp. butter		
	42	1,056
SUPPER:		
6 panned oysters on a slice toast	8	
2 h. tbsp. creamed potatoes	2	
2 h. tbsp. string beans		
1 a. s. sliced tomato	2	
1 baked banana with 1 tsp. sugar and lemon juice	1	
1 tbsp. butter		
1 glass milk	7	
	20	664
Total	76	2,390

RECIPES FOR DISHES APPROPRIATE FOR THE PATIENT WITH NEPHRITIS

	Carbohydrate	Protein	Fat	Calories
Bran Muffins:				
1 egg				
1 measuring cup butter milk				
2 tbsp. melted fat				
½ measuring cup flour				
½ measuring cup meal				
1 measuring cup Kellogg's bran				
1 h. tsp. baking powder				
½ tsp. salt				
	100.4	20.5	27.1	570
Makes one dozen medium muffins				
Each muffin contains	8.3	1.7	2.2	48
Spinach Salad:				
2 h. tbsp. cold spinach pressed and chilled in mold; may be garnished with a bit of hard boiled egg or sliced tomatoes and tsp. mayonnaise			2	57
Mayonnaise Made with Mineral Oil:				
Make same as ordinary mayonnaise only use mineral oil (1 pt. to 1 egg and leave out salt if desired).				
Panned Oysters:				
Six large oysters			5.2	40
Drain oysters and drop on hot butter pan for few seconds, turn and serve hot on medium slice toast			3	84
			8.2	128
Cream Dressing:				
1 tbsp. whipped cream				
1 tsp. sugar				
1 tsp. lemon juice				
A dash of paprika				
Mix well and serve on fruit salads =			1	125
Cream Sauce:				
1½ cup milk				
2 h. tbsp. flour				
2 h. tbsp. butter				
3 tbsp. =			1.8	91
Spanish Cream No. 1 (one serving):				
4 tbsp. medium cream				
1 tsp. sugar				
1 egg white				
1 tsp. Knox gelatin			7	
1 tbsp. cold water-lemon juice			6	

Spanish Cream No. 2:
1 h. tsp. Knox gelatin
2 h. tbsp. sugar
1 cup milk
1 egg
1 tbsp. Sherry or other flavoring
Two heaping tbsp. = 12 204

Orange Ice:
2½ cup orange juice
¼ cup lemon juice
1½ cup sugar
1 cup water
Rind of 2 oranges
2 heaping tbsp. = 1 312

Apple Whip: (one serving) Protein 4 Calories 310
1 medium baked apple
3 tsp. sugar
1 egg white
Put apple through sieve, add sugar, then egg white beaten stiff

Snow Pudding: (one serving) Protein 1 Calories 134
¾ cup water
1 h. tsp. gelatin
2 h. tbsp. sugar
1 tsp. lemon juice and rind of one lemon
1 egg white
4 h. tbsp.

Apple Tapioca: (one serving) Calories 226
1 a. s. apple
2 tsp. sugar
½ cup water
1 tbsp. minute tapioca
Nutmeg
1 tsp. butter

Baked Egg Custard: (one serving) Protein 5 Calories 350
4 tbsp. cream
4 tbsp. water
1 tsp. sugar
1 egg yolk

Soft Custard: (one serving) Protein 4 Calories 131
½ glass milk
1 heaping tbsp. sugar
1 egg yolk
Nutmeg
4 tbsp. to serving

NEPHRITIC DIET LIST OF O'HARE

O'Hare[18] and his associates have devised a simple and thoroughly satisfactory method for directing the diet of their patients at the Peter Bent Brigham Hospital. This is especially useful for the management of nephritis in the home.

Any combination of the foods listed below may be selected.
Foods not listed below must not be taken.
In Groups 1 and 2 there is a restriction in the total amount.
The foods in these groups must be served in full or half portions.
A full portion in Group 1 counts 1.
A full portion in Group 2 counts 2.

In Group 3 the quantity of each is not restricted, although you are urged to use discretion.

Points on recipes to count as indicated.

YOUR TOTAL SCORE FOR THE DAY SHOULD BE..............................
YOUR TOTAL AMOUNT OF FLUID SHOULD BE..............................PINTS

Do not add salt or spices to the food after it has been cooked.

Group 1

(Each full portion counts 1)

	Full Portion	Vegetables, Etc.	Full Portion
Bread (white)	1 av. slice	Baked beans	1 tbsp.
Bread (graham)	1 av. slice	Lima beans	1½ tbsp.
Uneeda biscuit	5 crackers	Potato, creamed	1 tbsp.
Shredded wheat	1 biscuit	Potato, mashed	1½ tbsp.
Graham crackers	5 crackers	Potato, baked	1½ med.
Cereals, Etc.		Potato, boiled	1½ med.
Oatmeal	2 tbsp.*	Canned corn	2½ tbsp.
Boiled rice	3 tbsp.	Green peas	2 tbsp.
Cornmeal mush	4 tbsp.	Beets	5 tbsp.
Cream of wheat	6 tbsp.	Spinach	4 tbsp.
Farina	6 tbsp.	Bananas	2 large
Macaroni	4½ tbsp.	Cream, heavy	⅔ cup

Group 2

(Each full portion counts 2)

	Full Portion	Fish	Full Portion
Milk	1 glass	Cod, boiled	1″ × 1″ × 1½″
Egg	1 egg	Haddock, boiled	1″ × 1″ × 1½″
Eggs (scrambled)	1½ tbsp.	Halibut, boiled	1″ × 1″ × 1½″
Flour, sifted	⅔ cup	Mackerel, boiled	1″ × 1″ × 1½″
Meats		Salmon, boiled	1″ × 1″ × 1½″
Lamb chop, broiled	⅔ chop	Smelt	½″ × 1″ × 3[illegible]
Lamb, roast	3″ × 2½″ × ¼″	Oysters	7 oysters
Beef, roast	3″ × 2″ × ¼″	Crabmeat, canned	2 tbsp.
Beef steak, broiled	2″ × 1″ × 1″	Salmon, canned	1½ tbsp.
Chicken, roast	3″ × 3″ × ⅛″	Shrimp, canned	6 small

* All tablespoonfuls are "rounded."

Group 3

(No restriction)

Vegetables

Asparagus
Cabbage
Carrots
Cauliflower
Celery
Cucumbers
Lettuce
Mushrooms
String beans
Tomato (fresh)
Tomato (cooked)
Onions
Squash
Turnips

Fruit

Apple
Apricot
Blueberries
Cherries
Cranberries
Grapefruit
Grapes
Muskmelon
Lemons
Oranges
Peaches
Pears
Pineapple
Plums
Prunes
Raspberries
Strawberries
Watermelon

Miscellaneous

Sugar
Maple sugar
Syrup
Honey
Candy
4 dates a day
3 Sunshine arrowroot cookies a day
Cornstarch
Arrowroot
Tapioca
Post-toasties
Butter
Olive oil

On this sheet are most of the ordinary foodstuffs used in any home. These foods are divided into three groups according to the amount of protein in them. In Group 3, there is so little protein that one can ordinarily ignore it. In Group 1, each full portion (indicated to the right of each foodstuff) contains approximately 4 Gm. of protein. In Group 2, each full portion contains approximately 8 Gm. of protein. To make it still simpler, we avoid mentioning grams and instruct the patient that each full portion in Group 1 counts one point. In Group 2, it counts two points. The number of points for the day is inserted in the blank space left for that purpose at the top of the sheet. A low protein diet would be represented by seven points (28 Gm.). A very generous protein diet—for a nephritic patient—would be equivalent to fifteen points (60 Gm.). Another blank line for the prescription of the amount of fluid is placed immediately under the prescription of protein. The physician may use his own discretion about allowing tea or coffee or substitutes for these. The patients are not allowed to add salt to the food after it comes to the table. The average patient under this regimen does not get more than 4 or 5 Gm. of salt a day. If he is edematous, we can still further decrease the salt by ordering fresh butter, salt-poor bread, vegetables, meats, etc., boiled free from salt, and, if necessary, the use of distilled water whenever water is used in the diet. The former method reduces the salt intake to approximately 2.0 Gm. a day, and the latter to perhaps as low as 0.5 Gm. a day.

NEPHRITIC RECIPES (O'HARE)

Rice Pudding—2 Points

¼ cup boiled rice.
¼ cup milk.
½ egg.
2 tsp. sugar.
2 tsp. raisins.

To the slightly beaten egg, add milk and other ingredients. Bake in moderate oven until lightly browned.

Vegetable Soup—0 Points

2 tbsp. onions, chopped.
2 tbsp. carrots, chopped.
2 tbsp. turnips, chopped.
3 tbsp. celery, chopped.
2 tbsp. butter.
1 pint water.

Cook all the vegetables in butter for 3 minutes. Add the water and boil ¾ hour or until vegetables are soft.

Ice Cream—1 Point

⅔ cup cream flavored as desired with fruit from Group 3 and sugar.

Cup Cakes — 2 = 1 Point

3 tbsp. butter.
¼ cup (scant) sugar.
½ egg.
¼ cup milk.
⅔ cup flour.
⅓ tsp. vanilla.
1½ tsp. baking powder.
(Ryzon or Dr. Price's).
Make into 6 cakes.

Short Cake — 2 = 1 Point

1⅕ cup sifted flour.
2 tbsp. lard or butter S. P.
½ cup (scant) milk.
2 tsp. baking powder.

Mix as biscuits and make into 8 biscuits.

Individual Pie—1 Point

⅓ cup flour.
1⅓ tbsp. lard.
⅛ tsp. baking powder (Ryzon or Dr. Price's).
Ice water to make a stiff dough.

This pie may be made with any fruit from Group 3 for filling. Cornstarch instead of flour should be used for thickening.

Bavarian Cream—1½ Points

1 tsp. granulated gelatin.
1½ tbsp. cold water.
¼ cup cream, whipped.
1 tsp. lemon juice.
2 tsp. sugar.
¼ canned peach chopped fine.
¼ cup boiling water.

Soak gelatin in cold water, dissolve it in boiling water; add lemon juice and sugar and chill until it is the consistency of heavy molasses. Stir in peach pulp or other fruit from Group 3; fold in whipped cream. Chill.

Baked Custard—2 Points

½ cup milk.
½ egg.
¾ tbsp. sugar.
Flavor with caramel or vanilla.

Beat egg slightly; add milk and other ingredients. Pour into mold and bake in moderate oven with mold standing in pan of water. NOTE: This custard may be steamed or boiled.

Tapioca Cream—1 Point

¼ cup milk.
1 tbsp. (scant) tapioca soaked overnight in 3 tbsp. cold water.
¼ tsp. vanilla.
⅓ egg.
1 tbsp. sugar.

Drain tapioca, mix with sugar and add slowly to milk scalding in double boiler. Cook till tapioca is clear. Stir in gradually the beaten ⅓ egg yolk; fold in lightly the beaten ⅓ white.

Creamed Vegetable Soups—1 Point

½ cup strained vegetables from Group 3.
½ cup milk.

Thicken with 1 or 2 tsp. cornstarch moistened in 1 tbsp. cold water.

Pineapple Mousse—½ Point

⅓ cup cream, heavy.
1½ tbsp. shredded pineapple.
½ tsp. lemon juice.
1 tbsp. sugar.

Whip cream, then fold in other ingredients, previously mixed. Pour into mold, cover, and pack in 3 parts ice to 1 part salt, for 1½ hours or until frozen through.

Blanc Mange—1 Point

2½ tsp. cornstarch.
¾ tbsp. sugar.
½ cup milk.
2 tbsp. cold water.
¼ tsp. vanilla.

Heat milk in double boiler, add cornstarch moistened in cold water and sugar. Cook until well thickened, add vanilla and chill. Fruit from Group 3 may be added.

Water Ice—0 Points

Any combination of fruit from Group 3 sweetened and frozen.

Nephritic Dressing—0 Points

(As used on salad, does not count any points.)

1 egg yolk.
1½ cups salad oil.
4 or 5 tsp. lemon juice.
1 tsp. sugar.

Beat the egg yolk, add 1 or 2 drops of lemon juice. Then drop by drop beat in the salad oil. Thin down with the lemon juice, adding only part of it at a time. Add sugar last.

BASE-FORMING DIETS

The acid-forming and base-forming qualities of the food are believed by many clinicians to influence materially the course of nephritis. Sansum, Blatherwick and Smith[12] have seen marked improvement follow the use of diets which are predominatingly basic. Below are given their tables of acid-forming and alkali-forming foods, together with a sample dietary:

Table 3.—*Acidity of Certain Foods* (*Sansum, Blatherwick & Smith*)

	Per Hundred Grams
Bread, white	2.7
Bread, whole wheat	3.0
Corn, sweet, dried	5.95
Crackers	7.81
Cranberries	*
Eggs	11.10
Egg white	5.24
Egg yolk	26.69
Fish, haddock	16.07
Fish, pike	11.81
Meat, beef, lean	13.91
Meat, chicken	17.01
Meat, frog	10.36
Meat, pork, lean	11.87
Meat, rabbit	14.80
Meat, veal	13.52
Oysters	30.00
Oatmeal	12.93
Peanuts	3.9
Prunes, plums	*
Rice	8.1

* The ash of these foods is alkaline, but because of contained substances which form hippuric acid in the body, they increase the acidity of the urine.

TABLE 4.—*Alkali-producing Foods (Sansum, Blatherwick & Smith)*

	Per Hundred Grams
Almonds	12.38
Apples	3.76*
Asparagus	81
Bananas	5.56*
Beans, dried	23.87
Beans, lima, dried	41.65
Beets	10.86
Cabbage	4.34
Carrots	10.82
Cauliflower	5.33
Celery	7.78
Chestnuts	7.42
Currants, dried	5.97
Lemons	5.45
Lettuce	7.37
Milk, cow's	2.37
Muskmelon	7.47*
Oranges	5.61*
Peaches	5.04
Peas, dried	7.07
Potatoes	7.19*
Radishes	2.87
Raisins	23.68
Turnips	2.68

* These foods have been found experimentally to be very efficient in reducing the acidity of the body.

A Basic (Alkaline) Diet (as Served) (Sansum, Blatherwick & Smith)

BREAKFAST

Baked Apple with Cream
Bacon
½ Slice Toast Jelly Butter
1 Glass Orange Juice 1 Glass Milk

LUNCH

Baked Stuffed Potato Beets in Cream
Combination Vegetable Salad
½ Slice Bread Butter Olives
Iced Cantaloupe
1 Glass Orange Juice 1 Glass Milk

DINNER

Cream of Spinach Soup
Escalloped Potatoes Buttered Peas and Carrots
California Fruit Salad
½ Slice Bread Butter
Apricot Ice Cream
1 Glass Orange Juice Raisins
Nuts

DISEASES OF THE URINARY PASSAGES

Pyelitis and Pyelonephrosis.—These conditions demand a type of dietary regulation which is suitable for almost any febrile disease. The severity of the infection, the height of the fever and the extent of the prostration should determine the degree of restriction. Simple, easily digested, nourishing food is needed. Milk should find a prominent place in the diet, to which should be added gruels with cream, soft boiled or poached eggs, toast or bread, butter and preserves. Orange juice and stewed fruits should also be given. The simpler desserts, such as rice or tapioca pudding and cup custard, are also permissible. There is danger always, particularly if the disease is long continued, that the restriction of food will be too rigid. In general, the diets advised for typhoid fever are suitable in the severer forms of this disease. Patients with the milder forms may be given more liberal diets, in which may be included tender meats, cooked fruits and the more easily digested vegetables.

Hydronephrosis and Tumors.—These diseases of the kidney require only such dietary regulation as is made necessary by the resulting impairment of renal function and the general debility. Diets suitable in renal impairment were discussed with chronic nephritis.

Phosphaturia, Oxaluria, Uraturia.—The colloids of the urine enable it to hold crystalloids in solution in much greater concentration than otherwise would be possible, which explains why the phosphates, oxalates and urates dissolved in the urine greatly exceed what would be the saturation point of a simple watery solution. In those disorders in which these salts are precipitated in abnormal quantities the fault is not primarily in their concentration; most often the concentration does not transcend normal limits. There is probably some change in the physico-chemical equilibrium of colloids and salts which impairs the "protective" influence of the colloids and thus permits a state of relative supersaturation to obtain. There are, then, three chief factors which determine the formation of urinary deposits: (1) concentration of the salt in question, (2) reaction of the urine, and (3) the protective influence of the colloids. The first factor in the vast majority of instances is of little or no influence; the second is of contributory influence; the last named is probably the chief factor.

Phosphaturia signifies a milky or cloudy appearance of the urine due to the presence of large numbers of phosphate crystals. This is not a disease but is a metabolic disturbance which may occur under a variety of conditions. It is frequently seen in emotional people or those who have been under severe mental strain; in such cases it possibly indicates a disturbance in the nervous control of the regulatory function of the kidney which influences acid base equilibrium. The precipitation of phosphate does not necessarily mean that the excretion of these salts is increased; it signifies merely lessened solvent power of the urine which is due in all probability to an alteration in the physico-chemical equilibrium of crystalloids and colloids. It is said that the ratio of calcium to phosphorus in the urine is abnormally high. Phosphaturia can be recognized by the cloudy appearance of the urine as well as the nature of the sediment and by the fact that the addition of a few drops of glacial acetic acid will cause the cloudiness to promptly disappear.

The *treatment* of phosphaturia consists not only in allaying any possibly nervousness which the patient may exhibit (bromides) but also in prescribing an acid-forming diet which at the same time is low in calcium. Such calcium-poor foods as meat, bread, and the cereal grains should be eaten liberally and those which are rich in this element, such as milk, eggs and the green vegetables, should as far as is consistent with good nutrition be avoided. At the same time the effort should be made to increase the acidity of the urine, for which purpose inorganic or organic acids may be administered. The same thing can possibly be accomplished by lessening gastric acidity. (Atropin gr. 1/200 three times daily.)

Oxaluria is a condition in which relatively large amounts of calcium oxalate crystals are precipitated in the freshly voided urine. These crystals form a large part of most kidney stones. This precipitation of calcium oxalate crystals is relatively independent of the reaction of the urine and of the concentration of these salts. It may obtain in both acid and alkaline urines and in urines which contain no more than the normal amount of dissolved oxalates. What, then, causes the precipitation of these crystals? No doubt a markedly increased oxalate output can be a favoring factor, but the chief factor, according to present-day views, is a lessening of the solvent powers of the urine for this salt. This is the accompaniment probably of a disturbance in the physico-chemical state of the urine, the nature of which is unknown.

Oxaluria is easily recognized by the large quantities of calcium oxalate crystals which appear in the urine. The microscopic appearance of these is typical.

The *dietary regulation* of oxaluria consists in the restriction of those foods which are rich in oxalates. In this respect foods may be grouped as follows: 1. Spinach, potatoes, beans, endive, tomatoes, dried figs, plums, strawberries, cocoa, chocolate and tea are rich in oxalates and should be avoided. 2. Bread, the muscle meats, liver, sweetbreads and the cereal grains contain oxalic acid only in small amounts and therefore may be eaten in moderation. 3. Milk, cheese, eggs, butter and other fats, peas, rice, cabbage, cauliflower, asparagus, mushrooms, apricots, grapes and melons contain little if any oxalic acid and therefore may be taken in liberal amounts.

Uraturia is a condition in which uric acid or urates are deposited in large quantities in the urine. This occurs only in acid urines. Most often the fault in this condition is not in the concentration of the urine in uric acid but rather in a change in its solvent powers. Uraturia should be clearly distinguished from gout, although both may occur in the same patient. The brick-dust sediment of uraturia is easily recognized; it disappears with moderate heating. The crystals of sodium urate found in this sediment vary greatly in size; they may appear in whetstone form or as rosettes.

The *diet* of uraturia should as far as possible be purin-free. The dietary regulations which were advised above for gout are entirely suitable in this disease, the chief feature of which is rigid limitation of meat and particularly of glandular organs. Milk and eggs are permitted. Large quantities of water preferably alkaline waters should be taken.

Kidney Stones.—Kidney stones are of three groups: phosphate, oxalate and urate. Usually they contain all three salts but one or the other may predominate. Oxalate and urate calculi develop, as a rule, in acid urines; the oxalates usually predominate. Phosphatic calculi often develop in the alkaline sediment of an infected urinary tract. It is difficult to say how much can be accomplished by dietary restriction. People whose families show a tendency toward the development of kidney stones should as a prophylactic measure practice dietary restriction. As a rule, however, this is not attempted until the person already has a stone and wishes to retard its growth or to prevent recurrence after removal. If it is possible to obtain a small calculus from the urine and to analyze this chemically, the dietary regulation will be greatly facilitated. The diets suitable for the several forms of kidney stone have been discussed above under the subjects of Phosphaturia, Oxaluria and Uraturia.

TABLE 5.—*Percentage Composition of Twenty-five Renal Calculi* (*Rosenbloom*)*

No.	Weight, Gm.	Moisture, Per Cent	Calcium Oxalate, Per Cent	Uric Acid, Per Cent	Phosphorus Pentoxid, Per Cent
1	5.8026	1.37	38.30	4.20	50.13
2	9.1904	4.30	40.60	6.72	58.16
3	0.5318	5.20	63.81	1.72	10.12
4	2.7525	2.80	7.72	90.10	
5	16.5630	8.70	33.90	4.80	53.46
6	1.5012	5.10	3.53	91.20	
7	1.3076	0.40	70.22	9.32	18.24
8	2.4723	1.06	91.30	6.71	3.82
9	3.1005	1.27	72.63	17.03	5.70
10	0.5246	0.60	98.60	1.12	7.30
11	5.7210	1.34	65.72	8.21	8.61
12	0.9205	0.78	90.76	7.92	6.82
13	0.4678	0.09	92.47	2.07	5.12
14	1.6240	0.63	90.82	3.17	4.18
15	1.9372	1.30	48.26	9.18	9.80
16	3.0042	3.20	47.22	6.72	7.56
17	1.2351	1.80	93.28	1.71	4.32
18	11.2678	1.65	94.27	0.62	3.74
19	8.5732	3.18	98.22	0.00	0.42
20	4.6002	2.75	94.17	1.82	6.10
21	4.7801	0.90	90.32	1.37	5.80
22	0.9763	0.09	95.12	0.24	6.22
23	1.2478	1.22	83.27	2.52	5.18
24	0.9908	0.78	39.93	7.62	3.42
25	3.2005	1.42	86.47	2.24	5.35
26	8.7632	5.81	82.17	9.35	3.72

* This table is taken from Rosenbloom, J.: A Further Study of the Chemical Composition of Urinary Calculi, J. A. M. A. **65**: 161, 1915. Kahn, M., and Rosenbloom, J.: A Report of Some New Chemical Analyses of Urinary Calculi with Indications for Treatment, ibid. **59**: 2252, 1912.

METABOLIC ANOMALIES

Alkaptonuria.—Alkaptonuria is a disease of intermediary metabolism, the chief manifestation of which is in the urine. On standing, the urine acquires a dark color due to the presence of homogentisic acid. This acid is probably a product of normal metabolism which in this disease escapes oxidation and, accumulating in the blood and tissues, is excreted in the urine. Eventually, it manifests itself in other ways also, by discoloration of the cartilages and occasionally by chronic arthritis. The seat of destruction of homogentisic acid is believed to be the liver, and the metabolic fault of this disease is probably to be found in this organ.

There is a familial tendency toward alkaptonuria which fact leads to the belief that it is an inherited anomaly. It is probably always congenital and belongs in what has been called the "inborn errors of metabolism."

As a rule alkaptonuria causes the patient no discomfort or inconvenience. He merely has a dark colored urine. At other times, however, a bluish-black discoloration of the cartilages, usually of the ear, known as ochronosis, and the chronic arthritis which develops later are sufficiently disturbing to demand treatment.

The *recognition* of this disease is made easy by the black discoloration which the urine assumes on standing (ammoniacal fermentation) or on the addition of a few drops of a ten per cent solution of sodium hydroxide.

The *treatment* is aimed at the limitation of homogentisic acid formation. Since this acid is derived from the amino-acids, tyrosin and phenylalanin, it is necessary to curtail as far as possible the intake of these. We can materially limit the exogenous supply of these bodies but we cannot, of course, stop the endogenous supply of protein cleavage products and the amino-acids which are derived from these. Protein metabolism should be reduced to the lowest figure which is compatible with nutritive safety. It is not feasible to draw distinctions as to the kind of protein eaten except as regards milk and milk products; for casein is especially rich in tyrosin and therefore the adult patient with this disease should take as little as possible of milk, cream and cheese. The child, however, is so dependent upon milk that even in the presence of alkaptonuria he should be permitted a small quantity, say one pint daily. The adult can to a certain extent compensate for his abstinence from milk by eating large quantities of green vegetables, such as lettuce, spinach, cabbage, cauliflower and the like, and secure his minerals and vitamins from these sources.

The degree to which protein restriction can safely be carried is difficult always to determine. (See Protein Problem, page 70.) It is not wise to eliminate protein altogether from the diet and thus force the patient to consume his own tissue proteins. It is best to permit him a certain minimal protein intake, the smallest amount which according to our estimations will preserve nitrogen balance and insure nutritive safety. This is two-thirds to three-fourths of a gram of good protein per kilo of body weight per day. In the case of a child the allowance should be at least 1 Gm. Thus for a man of 70 kilos, 45 to 50 Gm. of good protein daily would be appropriate. In order to accomplish this protein reduction without damage it is important that the diet in other respects be fully adequate and that at least 50 per cent of its total energy be in the form of carbohydrate. The patient should be given an abundance of cereals, bread and sweet things, and to insure sufficient minerals and vitamins, an abundance of fruits and green vegetables.

Cystinuria.—Cystin is an intermediary metabolic product which under normal conditions is destroyed as rapidly as it is formed. It does not normally appear in the urine except perhaps in minute traces. In the disease known as Cystinuria there is some defect of metabolism, probably a failure of some ferment, which defect permits cystin to escape oxidation and to accumulate in the tissues. It is then excreted in the urine where it appears in crystal form and may lead to the production of calculi. Like alkaptonuria it belongs among the "inborn errors of metabolism."

In the severer forms of cystinuria, particularly if the protein intake has been excessive, other amino acids, notably tyrosin, asparagin, arginin and lysin may appear in the urine. In the milder forms of the disease, however, the metabolic disturbance appears to be limited merely to a failure to oxidize the sulphur carrying amino-acid cystin.

The *diagnosis* is made by examination of the urinary sediment. Because cystin is soluble with difficulty it is readily precipitated from the urine; it appears in the form of small, flat hexagonal crystals. If the cystin is still in solution a few drops of acetic acid will cause its crystals to appear. These crystals are readily soluble in ammonia and hydrochloric acid and are insoluble in water, acetic acid and ether.

This disorder may be accompanied by no symptoms. As a rule, however, the crystals are deposited in the kidneys and at other locations in the urinary tract and eventually produce symptoms. Cystin calculi may form in any part of the urinary tract and the resulting symptoms do not differ from those produced by other calculi. The rapidity of their growth and their location determine in large measure the symptoms.

Treatment.—The treatment of cystinuria is similar to that of alkaptonuria (see above). This sulphur-carrying amino-acid is a constituent of all food proteins. We can by rigidly curtailing the protein intake thus lessen the amount of cystin which comes from food, but we cannot reduce beyond a certain point the endogenous supply which comes from the destruction of the patient's own tissues. The diet above outlined for alkaptonuria is entirely suitable for cystinuria except in one respect: the objection to milk noted in alkaptonuria does not hold good in cystinuria; milk need not be restricted further than is indicated by its protein content. Klemperer and Jacoby, and Smillie report satisfactory results in the treatment of this metabolic anomaly by means of protein restriction and the administration of large amounts of alkali.

These observers recommend that the urine be kept at all times alkaline to litmus. This may be accomplished by the administration of large amounts, say four to six grams daily, of sodium bicarbonate. In addition the patient should drink large quantities of water.

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CHAPTER XVII

DISEASES OF THE DIGESTIVE ORGANS

GENERAL CONSIDERATIONS

Disease of the alimentary tract, particularly of the stomach, is not so frequent as is commonly believed. True, abdominal discomfort related in point of time to the taking of food, is fairly frequent, but it is not necessarily due to disease of the stomach or intestines. It may be due to psychic factors, to an overloaded colon, to disease of the other abdominal organs, such as the liver, gallbladder or appendix, or to disease still more remotely located. The nature of the patient's digestive discomfort can usually be determined with a fair degree of accuracy by careful clinical study, but occasionally the underlying cause is so remote or so elusive as to escape detection. The problem, therefore, is not solely the kind of food needed, but also whether dietary restriction at all is advisable. Carefully planned diets suitable for organic disease may, if the trouble is purely psychic, make the patient worse and, if continued long, perhaps cause permanent invalidism. Hence the necessity for a critical study of each patient, with a careful weighing of emotional as well as physical factors.

Foremost among the considerations which determine the suitability of diet is that quality of the food which we call digestibility. This has never been clearly defined.[1] For our present purposes, we count as most digestible that food which, without injury, gives the patient the greatest degree of comfort and satisfaction. Brugsch has attempted to define this further by stating that the more closely a food approaches the fluid form the more digestible it is, while the greater its residue, the more compact its form and the greater its mechanical effect, the more difficult it is of digestion. Rehfuss, Hawk and their associates have adopted a similar criterion in their assumption that the longer the food remains in the stomach the more difficult it is to digest. This is the usually accepted guide, but its accuracy is merely approximate, and there are many exceptions. Many variables combine to determine the ease or difficulty with which a person will digest a certain food. Even in health, personal idiosyncrasy, racial custom, climate, the weather, the person's general physical state at the moment, and psychic influences are all at times determining factors. In disease there are still more variables, and the difficulty is increased accordingly.

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[1] For a full discussion of the digestibility of the various foods the reader is referred to Chapter IV.

In selecting the patient's food according to digestibility, the physician must rely in part on general experience and in part on the carefully scrutinized experience of the individual patient. He must be on his guard, however, against phobias and misconceptions, for nervous patients sometimes have the most bizzare ideas as to what they can or cannot eat. At times it may be necessary to apply the test of "trial and error," and on the result of this to determine the most suitable diet. The scales furnish an excellent answer to this question, for if there is satisfactory gain in weight it is evident that the food is being digested and assimilated; in addition, a fairly good idea as to the completeness with which the food is utilized can be obtained from the examination of the feces.

Since the consistency of the food determines in a measure the work demanded of the stomach, liquids and semisolid foods should be given when, as in gastritis, the effort is to spare the stomach, and dry foods when, as in gastric atony, the purpose is to give it exercise and stimulation. The old question as to whether it is wholesome to drink water with the meals has been emphatically answered in the affirmative by Hawk and others. The temperature of the food and drink is worthy of comment; it is often necessary to warn particularly against very hot or very cold drinks.

What is the chief object of dietary regulation in diseases of the digestive organs? Is it to spare these organs as much as possible and thus to permit them through rest to recuperate? In some instances such a procedure is good; in others it is bad. In acute gastritis, in gastric ulcer and in acute diarrhea, for instance, rest of the digestive tract is obviously needed; fluids, chiefly milk, and semisolid foods are given. On the other hand, in mild chronic gastritis with subacidity, and particularly in functional disorders of psychic origin, too much protective therapy may work harm. Chewing stimulates the flow of gastric juice and increases gastric acidity, which is of help in diseases accompanied by subacidity, but this advantage is lost if the patient is not given anything to chew. It is also obvious that to rest the stomach of a psychasthenic is bad practice; his chief need is to be convinced that his digestive organs are competent, and that they can be induced to do their work.

In constructing the diet it is necessary always to take into consideration the nutritional factors of fundamental importance which were discussed in the first part of this book; that is, caloric value, protein content, and the need for vitamins, minerals and roughage. It may not be possible in every case to meet all nutritive requirements, but effort in this direction should always be made. It is important that the patient have enough food to meet in full his need for energy. The old starvation treatment of digestive diseases is fortunately now a thing of the past, and it is generally recognized that it is difficult to cure a patient of any disease (except perhaps acute gastritis) by prolonged starvation. The diet should be scrutinized with respect to all of the essential nutritive factors.

Milk is the most useful of all foods in the treatment of gastrointestinal diseases. Not only does it supply the necessary nutritive elements more satisfactorily than any other single food, but it throws the least possible burden on the digestive tract. True, it is believed to cause constipation in some people; but this and the other objections which have been offered to its use can usually be overcome, and they are greatly outweighed by the advantages. Sugars and sugary foods when not too concentrated are usually well borne in most digestive disturbances. Concentrated sugary foods, however, especially when taken on an empty stomach, will irritate the gastric mucosa; for this reason such foods should be taken preferably at the end of the meal.

The stimulating influence of meat and meat extract is often of benefit in the treatment of digestive disorders. It is a popular belief, sometimes encouraged by physicians, that abstention from meat will cure stomach troubles, but the fallacy of this is seen not only in everyday clinical experience, but also in the fact that an animal which has been deprived of his stomach can digest and absorb proteins in an entirely satisfactory manner. Almost any tender meat is suitable except pork; because of its high fat content, many patients find the latter difficult to digest. At one time German physicians, and following them many American physicians, gave patients with stomach troubles thin slices of raw ham, but even the originators of this custom have now abandoned it. When the patient has no appetite and the secretion of gastric juice is limited, meat extracts in the form of bouillon or broths aid digestion. On the other hand, there are diseases, such for instance as ulcer of the stomach, in which stimulation is to be avoided; in these diseases such foods should not be given.

Fats as a rule should be avoided, for they depress the secretion of hydrochloric acid and leave the stomach more slowly than other foods. On the other hand, there are certain diseases accompanied by hyperacidity in which a high fat diet containing an abundance of cream is desirable. After all, the experience of the individual patient is the best guide as to the amount of fat he can comfortably take.

Gelatin is of peculiar value in the feeding of patients with digestive diseases. It is an incomplete protein but because it is well borne and because there can be added to it other foods in almost any combination, it is a useful article of diet. It may be eaten as a refreshing dessert with sugar, cream and various flavoring extracts, or it may be taken with meat extracts, in which form it has definite satiety value.

Appetite profoundly influences digestion (Pawlow); therefore an important part of the treatment in many digestive disturbances is the stimulation of the desire for food. The so-called bitter tonics and similar drugs, except for the psychic effect, are probably valueless and should seldom be used. Careful attention to such details as will give to the food a distinct appeal is the best means of increasing the appetite. The preparation of the food and its amount and variety, the arrangement of the tray or table, neatness of linen and utensils, surroundings, cheerful atmosphere and a thousand and one other psychic factors are all of importance.

The arrangement of the meals both as to frequency and as to amount must receive consideration. Even though the usual regimen of three meals daily may be suitable, it is necessary to see that the most advantageous distribution obtains: in one case more breakfast should be eaten and in another a heavier mid-day meal and less supper. In many instances, five meals daily should be taken, and in a few (ulcer of stomach) the feedings should be even more frequent.

The care of the mouth is of importance in the interest both of efficient mastication and of good appetite. Improved mastication and the relief from oral sepsis which follow the institution of needed dental work will sometimes put a stop to chronic gastritis. In the same category should be included the removal of diseased tonsils. A clean mouth promotes appetite, and in this way also aids digestion.

Directions as to diet should be explicit. If the patient has a genuine disease, exact instructions are obviously necessary, and if his troubles are not organic but are largely psychic, it is equally important that he be not left to the mercy of his own vagaries. It should be emphasized, however, that the physician who gives the patient a printed diet slip torn from a pad makes a twofold error. In the first place, from a nutritional standpoint such cut and dried methods without individualization are always a mistake; in the second place, it is bad psychotherapy to let the patient see that he is merely a case; he must be treated as an individual, not simply as one of a group. His confidence in his physician is likely to be lessened if he is given a printed sheet. Written instructions are excellent, oftentimes essential, but they must not be printed.

THE ESOPHAGUS

Stenosis of the Esophagus.—This condition may be produced by pressure from adjacent structures or by intra-esophageal disturbances. Among the former, aneurysm and mediastinal growths are most frequent, while among the latter, particularly in adults, carcinoma and cicatricial constriction come first, and after them in the order of frequency, spasm (cardiospasm), diverticula, and foreign bodies.

A danger incident to all esophageal obstruction, particularly if it be from cancer, is starvation. The first effort always should be to give food through the natural channels, but if sufficient nourishment to meet the patient's needs cannot be taken in this manner and starvation is imminent, then a gastrostomy opening should be made. Skilful dilatation begun early will often obviate this operation.

The character of treatment, whether by dilation, irradiation or otherwise, is determined by the nature of the obstruction, but the diet should be essentially the same whatever the cause. The food in organic stenosis should be liquid and semiliquid. Milk (1 or 2 quarts daily), cream and raw or soft-boiled eggs are the usual foods. When the stenosis is not marked, milk toast, cereals with cream and purees may also be given. Cream may be added to the milk up to one third of its volume, provided this mixture is not too rich for the patient's comfort. It is best to give small amounts of food at frequent intervals, which is especially to be recommended when regurgitation is present; small amounts of liquid, say a tablespoonful, will sometimes find passage into the stomach when larger amounts would be regurgitated.

When the stenosis appears to be so great that little or no food can be taken, it does not necessarily follow that final obstruction is at hand; for superimposed inflammatory swelling will occasionally cause complete obstruction which subsides when the patient is given a short rest from instrumentation and mouth feeding. When the obstruction permanently reaches the point where sufficient nourishment cannot be given by mouth, then gastrostomy should be performed.

Cardiospasm.—Cardiospasm with dilatation of the esophagus above the obstruction is sometimes difficult to distinguish from true organic stenosis. It can usually be recognized by the following characteristics: the obstruction is likely to be more complete than with organic stricture, and the proximal dilatation greater; it varies in severity from time to time; occasionally, in this type of obstruction, solids can be more easily swallowed than liquids. No special dietary precautions are to be observed, except that excessively hot or cold drinks and irritating foods should be avoided. Dilation by means of a rubber bag designed for this purpose will usually give relief for long periods.

GASTRITIS

Acute Gastritis.—This condition always demands the same dietary regulation, whether it comes from: (*a*) gross errors in diet; (*b*) some ingested poison, bacterial or mineral, or (*c*) the toxin of an infectious disease. If either of the two first named causes is still operative when the patient is first seen, the stomach should be emptied promptly by lavage. Thorough washing with a large quantity of water containing a little bicarbonate of soda will remove all food remnants and mucus, and in the milder cases will accomplish much toward recovery. After the stomach has been thoroughly emptied, it may be well to hasten the cleansing process by irrigating the colon. Subsequent purgation by means of castor oil or some saline is also advisable.

For a time no food should be given. The stomach exhibits wonderful recuperative powers when permitted to rest, and if no food is forced on it for a period of from twenty-four to forty-eight hours and the original cause of the gastritis is no longer operative, it will as a rule promptly recover. Even the water taken by mouth should be restricted. To relieve thirst, the patient may take cracked ice, small quantities of hot water, or perhaps small amounts of carbonated water. If there is nausea, or if prostration is profound, a little dilute alcohol in the form of champagne or whiskey diluted with Appollinaris Water should be given every three or four hours. In the severer cases, plain tap water or glucose solution by rectum by the Murphy drip method should be given. Recovery is hastened if the patient is kept in bed.

After one or two days, feeding is usually begun. Milk is the best food. Broths thickened with rice or some other cereal may be taken, but milk, milk toast and cereals with cream are to be preferred to the more stimulating broths. A soft diet, bland and nonirritating, should be continued for a week or ten days, perhaps longer. Milk, cereals with cream, toast, butter, preserves, fruit juices, baked apple, rice pudding, tapioca pudding, cup custard and soft boiled or poached eggs meet these specifications. For several weeks all woody vegetables and other coarse foods should be avoided. Only tender meats should be taken.

When, as in infectious diseases, the cause of the gastritis persists, the liquid diet should be continued.

Chronic Gastritis.—This is said by many writers to be relatively rare, and it is suggested that much of the so-called catarrhal gastritis of the older writers represented digestive neuroses or other extragastric disease (gallbladder, appendix). On the other hand, it is not unlikely that a mild degree of chronic inflammation of the gastric mucosa, the result of dietary fault, is today a fairly frequent but unrecognized disease. Long continued unrecognized gastritis of this character will possibly explain the origin of achylia gastrica.

To distinguish chronic gastritis, from "nervous dyspepsia" on the one hand, and early carcinoma, on the other, is not always easy. The lack of appetite, amounting at times to nausea, the sense of pressure and dull epigastric pain after eating, the eructation of food and the "heart burn" are all fairly characteristic of gastritis. The absence of neurotic stigmas may serve to distinguish it from a gastric neurosis, but it should be emphasized that chronic gastritis itself may produce all manner of nervous symptoms and may give the patient the appearance and demeanor of a neurasthenic. Carcinoma of the stomach may present any or all of the symptoms above enumerated. It can as a rule, but not always, be recognized through its roentgenologic signs. Occasionally, in the absence of tumor, the differentiation of the two is difficult. Examination of the gastric contents is always of help in the recognition of chronic gastritis; although there are exceptions, to warrant this diagnosis the stomach contents should show much mucus and, except in the early stages, diminished or absent hydrochloric acid.

As the result of long continued chronic gastritis the stomach mucosa may show extensive changes, both gross and microscopic. In the early stages, the glands present little evidence of change although there is considerable interstitial infiltration surrounding them. Later they show a gradually progressive atrophy, which after many years may lead to a true "gastritis progressiva atrophicans." This tendency toward atrophy is characteristic of all chronic gastritis, and there is a definite relationship between the duration of the gastritis and the extent of the glandular atrophy. Occasionally there is a proliferation of the mucosa which leads to polyp formation, or the inflammatory reaction may involve the submucosa in such a manner as to cause contraction and narrowing of the lumen and to produce finally what has been called linitis plastica.

Removal of the cause of the gastritis, if possible, should precede attempts at dietetic therapy. The cause may be direct, such for instance as excessive indulgence in alcohol, the use of irritating drugs, or indiscretions in diet; or it may be indirect and represent merely a phase of some other disease more remotely located. Old drinkers have chronic gastritis and present the disease in its typical form. Among the irritating drugs which may be responsible, salicylates, iodides and drastic purgatives take a prominent place. Among the faulty dietary habits which are as common etiologic factors may be included the use of highly seasoned foods and of very hot or cold drinks, rapid eating with poor mastication, overloading of the stomach, and a preference for very coarse foods (vegetarian diets). Prominent among the indirect causes are pulmonary tuberculosis and syphilis. Various other chronic diseases, notably cirrhosis of the liver, nephritis, diabetes, myocardial failure and polyarthritis, may be accompanied by gastritis. Removal of the cause if it is direct, or treatment of the underlying disorder, if it is indirect, should always come first.

The *dietary treatment* of chronic gastritis therefore often consists in the correction of errors in eating. The meals should be eaten slowly, and the food should be thoroughly masticated. No food which is difficult to masticate thoroughly should be permitted. If the teeth are at fault, as is frequently the case, they should be taken care of, and missing teeth should be replaced by artificial appliances. Since the act of mastication stimulates the flow of gastric juice, it is obviously much better to prescribe foods which must be chewed, and thus to induce an increased flow of hydrochloric acid whenever possible, than to administer the necessary acid by mouth. No alcohol should be permitted, or, if the patient is an old alcoholic, only small amounts with the meals. The food should be simple and should not be highly seasoned. Pepper and other seasonings should be used sparingly, and only small amounts of salt should be taken. If these rules of hygiene are observed and the food is well prepared, its choice is not of great importance.

Milk, in my opinion, is always good in chronic gastritis in spite of the many statements to the contrary. The constipation which it is sometimes said to cause can be corrected by the use of agar or by milk of magnesia. The diarrhea which it may produce is usually dependent on the accompanying achylia, and can as a rule be corrected by the administration of hydrochloric acid.

Too much food should not be taken at one time, and to this end it is sometimes advisable to give milk or milk and egg at stated intervals between meals. All foods should be carefully prepared, and coarse particles excluded. Coarse, woody or stringy vegetables, tough meats and bran or whole wheat should not be permitted. Gruels, such as rolled oats, farina and cream of wheat are excellent and are well borne by the stomach, but in addition, carbohydrate foods which require mastication must also be given; toast is excellent for this purpose, since it requires chewing and at the same time is of easy chymification. It is sometimes well to insist that a good part of the carbohydrate be in the form of dry toast.

Vegetables should be served as purees, and in this form can be taken in liberal amounts. Likewise, fruits should be eaten cooked. Apples and raw fruits are usually harmful, but thoroughly ripe (spotted) bananas are, contrary to popular belief, well borne. Fruit juices may be taken, among which orange juice, because of its vitamin content, should have a prominent place.

The protein of the diet should come largely from milk and eggs; to a less extent, from tender meats. Eggs may be taken in any form except fried. Any meat except pork is suitable, but it must be well prepared and tender. There is no difference in this connection between white and dark meats. Meat stews, if not too highly seasoned, are excellent. Dried and smoked meats should be avoided.

Fats are preferably taken in the form of butter and cream. Crisp bacon in small amounts is often good.

In order to prepare the stomach for food, lavage with lukewarm water containing a little bicarbonate of soda is often advisable. It may be done daily, preferably before breakfast, and the patient may be taught to do it himself. Be reasonably sure, however, that he really has the disease, for a neurasthenic should never be started on this road.

The correction of constipation is sometimes demanded. Drugs are bad, and it is inadvisable in this disease to give the coarse foods usually prescribed for constipation, such as bran, graham bread and bulky vegetables. Two remedies are appropriate; mineral oil and plain agar. I greatly prefer the latter, because it is less likely to upset the stomach, and because it gives to the intestinal contents the necessary bulk and consistency. It may be eaten as a breakfast food with cream and sugar, or it may be taken direct in the mouth (after meals) and swallowed with the aid of a little water. The latter method is best. From two to four teaspoonfuls daily usually suffice, but it can be safely taken in any reasonable amount.

A discussion of diet in chronic gastritis would not be complete without some mention of the necessity, when the gastric acidity is low or achylia is present, of administering diluted hydrochloric acid. This should be given in doses of 30 drops, or perhaps even a dram or more, after meals.

Chronic Gastritis with Hyperacidity.—Such a condition occasionally occurs and is difficult to distinguish, except by roentgenologic means, from gastric ulcer. The type of diet suitable for this form of gastritis differs from that just described in that larger amounts of milk, cream and foods rich in protein are desirable. The usual gastritis diet may be made suitable by the addition of more milk, more eggs and finely chopped meats; or the diet advised for the later weeks of gastric ulcer may be found suitable (see page 511). All foods which stimulate gastric acidity, such as broths, meat soups and highly seasoned articles should be studiously avoided.

SPECIMEN DIETS SUITABLE IN CHRONIC GASTRITIS

I.	Calories
7 a. m.: One orange juice	50
8–8:30, Breakfast:	
2 tbsp. oatmeal strained with 1 tsp. sugar and 2 tbsp. cream	
1 poached egg on average sized slice of bread toasted	
1 glass milk	581
11 a. m.: Milk shake (made with 1 egg, 1 tsp. sugar and milk)	280
1–1:30, Dinner:	
1 French lamb chop, some fat	
Medium sized baked white potato with 1 tsp. butter	
2 heaping tbsp. spinach	
2 m. s. slice bread toasted	
2 h. tbsp. rice custard with 1 tbsp. whipped cream	
1 glass milk	
½ tbsp. butter	1,162
4 p m.: Milk shake	280
6–6:30, Supper:	
2 soft boiled eggs	
2 h. tbsp. cream of wheat with 1 tsp. butter	
3 h. tbsp. puree of green peas	
1 very ripe banana baked with 1 tsp. sugar and lemon juice	
2 average sized slices stale bread or toast and 1 tbsp. butter	
1 glass milk	940
8:30 or 9:00, Glass milk	157
Total calories	3,450

II.	Calories
7 a. m.: 1 cup warm water with pinch of soda	
8–8:30, Breakfast:	
1 m. s. baked apple with 2 tbsp. cream	
2 h. tbsp. farina with 2 tsp. sugar and 2 tbsp. cream	
1 shirred egg with 1 st. crisp bacon	
1 a. slice dry toast; ½ tbsp. butter	
1 glass milk	892
11 a. m.: Milk shake	280
1–1:30, Dinner:	
A. s. broiled chicken	
1 h. tbsp. well cooked rice with 1 tsp. butter	
2 h. tbsp. puree of lima beans	
2 h. tbsp. egg custard	
2 slices dry toast or stale bread	
1 tbsp. butter; 1 glass milk	1,008
4 p. m.: Milk shake	280
6–6:30, Supper:	
1 egg omelet	
4 h. tbsp. creamed potatoes	
2 h. tbsp. (well cooked and strained) squash	
3 h. tbsp. tapioca pudding	
2 a. s. slices dry toast; ½ tbsp. butter	
1 gl. milk	841
Bedtime: 1 glass milk	157
Total calories	3,458

III.	Calories
7 a. m.: Juice of 1 orange	
8–8:30, Breakfast:	
3 h. tbsp. cornmeal mush well cooked with 1 tsp. sugar and 2 tbsp. cream	
1 scrambled egg with 2 strips crisp bacon	
1 a. slice bread dry toasted with 2 tsp. butter	
1 h. tsp. orange marmalade; 1 glass milk	870
11: Milk shake	280
1–1:30, Dinner:	
A. h. roast lamb	
2 h. tbsp. mashed potatoes	
2 h. tbsp. well cooked spinach	
2 slices dry toast or stale bread; 1 tbsp. butter	
2 h. tbsp. rice custard with 1 tbsp. whipped cream	1,024
4 p. m.: 1 cup malted milk made with 1 cup milk and 1 heaping tbsp. malted milk powder	220
6–6:30, Supper:	
2 soft boiled eggs	
M. s. baked potato and 1 tsp. butter	
3 h. tbsp. puree of peas	
2 a. s. slices dry toast and ½ tbsp. butter	
2 h. tbsp. Blanc Mange (made with: ½ h. tbsp. cornstarch 1 tbsp. sugar 1 egg 1 cup milk, flavor)	
1 glass milk	891
Bedtime: 1 glass milk	157
Total calories	3,442

IV.	Calories
7 a. m.: Juice of one orange	
8–8:30, Breakfast:	
2 h. tbsp. strained oatmeal with 2 tsp. sugar and 2 tbsp. cream	
1 soft boiled egg	
1 a. s. slice dry toast with ½ tbsp. butter and 1 gl. milk	683
11 a. m.: Milk shake	280
1–1:30, Dinner:	
4 inch patty scraped beef, broiled	
M. s. baked potato with 1 tsp. butter	
2 h. tbsp. mashed turnips	
2 a. s. slices dry toast or stale bread with 1 tbsp. butter	
2 h. tbsp. Spanish cream with 1 tbsp. whipped cream	
1 glass milk	1,108
4 p. m.: Milk shake	280
6–6:30, Supper:	
1 egg scrambled with 1 tbsp. stewed tomatoes and 1 tsp. butter	
2 h. tbsp. cream of wheat with 1 tsp. butter	
2 slices dry toast with 1 tbsp. butter	
Large baked apple with 1 helping tbsp. whipped cream	
1 glass milk	869
Bedtime: Glass milk	157
Total calories	3,377

V.	Calories
7 a. m.: Juice of one orange	
8–8:30, Breakfast:	
2 heaping tbsp. farina with 1 tsp. sugar and 2 tbsp. cream	
1 shirred egg with 2 st. crisp bacon	
1 a. s. slice dry toast with 1 tsp. butter and 1 tsp. jelly	
1 glass milk	752
11: Glass milk	157
1–1:30, Dinner:	
1 French lamb chop	
4 h. tbsp. creamed potatoes	
2 h. tbsp. mashed squash	
2 slices dry toast or stale bread with ½ tbsp. butter	
2 h. tbsp. baked egg custard	
1 glass milk	939
4 p. m.: Milk and egg shake	280
6–6:30, Supper:	
2 egg omelet	
3 h. tbsp. meal mush with 1 tsp. butter	
3 h. tbsp. puree of peas	
2 slices zwieback with 2 tsp. butter	
3 h. tbsp. tapioca pudding	
1 glass milk	948
Bedtime: 1 glass milk	157
Total calories	3,233

VI.	Calories
7 a. m.: Juice of one orange	
8–8:30, Breakfast:	
3 tbsp. cornmeal mush, well cooked (3 to 4 hours) with 1 tsp. sugar and 2 tbsp. cream	
1 egg scrambled	
1 a. s. slice dry toast with ½ tbsp. butter and	
1 tsp. marmalade	
1 glass milk	575
11: Milk and egg shake	380
1–1:30, Dinner:	
A. h. roast chicken	
1 h. tbsp. boiled rice with 1 tsp. butter	
2 h. tbsp. puree of lima beans	
2 h. tbsp. prune souffle with 1 tbsp. whipped cream	
(½ cup prunes cooked and seeded; 1 egg white)	
2 a. s. slices dry toast with ½ tbsp. butter	
1 glass milk	1,084
4 p. m.: 1 glass milk	157
6–6:30, Supper:	
1 shirred egg	
1 m. s. baked potato with 1 tsp. butter	
2 h. tbsp. spinach	
2 a. s. slices dry toast with 1 tbsp. butter	
1 very ripe banana baked with 1 tsp. sugar and lemon juice	906
1 glass milk	157
Bedtime: 1 glass milk	
Total calories	3,259

VII.	Calories
7 a. m.: Juice of one orange	
8–8:30, Breakfast:	
5 h. tbsp. puffed rice with 2 tsp. sugar and	
¼ glass milk and 2 tbsp. cream	
1 soft boiled egg	
2 a. s. slices dry toast with 1 tbsp. butter and	
1 tbsp. apple sauce	811
1 glass milk	
11: Glass milk	157
1–1:30, Dinner:	
A. h. very tender roast beef or stew	
2 h. tbsp. mashed potatoes	
3 h. tbsp. creamed cabbage	
2 h. tbsp. apple tapioca with 1 tbsp. whipped cream	
2 a. s. slices dry toast or stale bread with 1 tbsp. butter	
1 glass milk	935
4 p. m.: Milk and egg shake	280
6–6:30, Supper:	
1 egg souffle; ½ tbsp. butter	
Boiled macaroni with 1 tsp. butter	
3 h. tbsp. carrots mashed with 1 tsp. butter	
1 a. s. slice dry toast with ½ tbsp. butter	
1 h. tbsp. bread pudding with 1 tbsp. whipped cream	
1 glass milk	786
Bedtime: 1 glass milk	157
Total calories	3,126

GASTRIC AND DUODENAL ULCERS

In the following discussion little distinction will be drawn between gastric and duodenal ulcer. The seats of predilection of both, the pars pylorus and the pars horizontalis superior, are biologically the same; they have the same pathogenesis, they are subject to the same corrosive influence of the digestive juices, and they have essentially the same symptomatology. True, the duration of the history, the time of appearance of pain, the degree of food relief and above all the roentgenologic findings when positive, will give evidence as to location. But the two respond in like degree to the same type of treatment; therefore they demand in principle the same dietary regulation.

The Pathogenesis of Peptic Ulcer.—This has been the subject of diverse opinion based both on clinical speculation and on experimental evidence. The causes are believed to be of two kinds, predisposing and determining. Among the former is included heredity. "Ulcer families" have been reported;[2] and in this category have been placed also certain constitutional states, such for instance as habitus asthenicus and status lymphaticus. People who are subject to vagotonia[3] and other nerve disturbances which may lead to localized spasm of the gastric musculature[4] are said to be prone to ulcer. Occupation may be a predisposing factor in that a stooped-over position or constant pressure on the epigastrium may be productive of ulcer.

The gastric juice no doubt plays a mere secondary rôle. True, hyperacidity and hypersecretion frequently accompany ulcer, but whether this is the result of the ulcer or whether all are dependent on a common cause, is not of great moment. Hyperacidity alone does not produce ulcer.

Whatever the influence of predisposing factors, and one cannot but question their influence, there is one determining factor which is operative in every case; localized interference with the circulation.[4] This is essential to the production and continuation of the typical ulcer, for without such circulatory disturbance and its resulting ischemia, an erosion or other trauma of the mucosa will, as a rule, promptly heal. It is only when the mucosa has been deprived of the protective influence of the blood that action by the acid gastric juice is possible. Continued digestion of the mucosa under these circumstances tends to produce an ever deepening ulcer.

The manner in which this circulatory disturbance originates is not necessarily always the same. It has been suggested that in youthful persons reflex nervous influences (vagotonia) may lead to the contraction of an arteriole or to spasm in a limited area of musculature, either of which can produce a damaging ischemia in the mucosa.[5] In elderly people with arterial disease, thrombosis may have the same effect. The belief, however, is gaining ground that infection is most often the responsible factor. In fact, many clinicians, following Rosenow,[6] Haden[7] and others, believe that infection is the only etiologic factor of importance. The evidence seems convincing that the mouth, tonsils and accessory nasal cavities may furnish foci from which bacteria gain entrance to the blood stream to find lodgment finally in the smaller vessels of the gastric and duodenal mucosa. In this manner an area of necrosis arises, and being deprived of its blood supply, the resulting defect is constantly subjected to the erosive influence of the digestive juices.

Recognition of Peptic Ulcer.—In the majority of instances, this is not difficult. In rare instances the ulcer is latent, and as the first indication of its presence a copious hemorrhage or even perforation appears. Occasionally it will pursue an atypical course, such as will give rise to a diagnosis of nervous dyspepsia or of chronic gastritis, and the first intimation of the real trouble is seen at necropsy in a manifest round ulcer or in an old scar. As a rule, however, the chronic ulcer pursues a typical course and produces characteristic symptoms. The epigastric pain, a true hunger pain often described as burning, piercing or boring, coming on practically always at the same time after meals, sometimes several hours later, is characteristic. The gastric hyperacidity and the presence of occult blood in the feces help in the diagnosis. The persistence of symptoms through weeks, months and years, with occasional periods of remission, giving to the disease a certain periodicity, is also characteristic.

Other diseases—appendicitis, cholecystitis, carcinoma and gastric neurosis—may simulate ulcer. On physical examination appendicitis as a rule gives evidence of a pathologic condition in the right iliac fossa. Cholecystitis gives rise to a pain which is likely to be more acute than that of ulcer, and which is more frequently localized in the right hypochondrium. In both of these conditions the distress is more variable as to character and as to time of appearance; and neither of them is prone to show the remissions exhibited by ulcer. Carcinoma is sometimes difficult to differentiate from simple ulcer. Advanced years and a persistent lack of appetite with particular distaste for meat are suggestive of carcinoma. Not infrequently, however, the diagnosis cannot be made in the absence of tumor without resorting to roentgenography; even when a lesion has the appearance of ulcer on a roentgenogram but is of very large size, carcinoma should be suspected. The gastric neuroses are sometimes difficult to distinguish from ulcer because the epigastric distress of either may simulate that of the other. Variability of symptoms and their relative independence of diet, together with neurotic stigmas, are always suggestive of a neurosis. After all, roentgenography offers by far the most satisfactory method of recognizing ulcer; the presence of a niche, hypertonus, hypotonus, abnormalities of peristalsis and abnormal emptying time, sometimes rapid and sometimes delayed, are all valuable signs.

Relative Merits of Medical and Surgical Treatment of Ulcer.—This cannot be discussed in full here, even though it were possible for me to escape the charge of bias. Briefly, it can be said that a large body of medical men of experience are satisfied that prolonged and careful medical treatment will cure the vast majority of patients who have peptic ulcers, and that this method of treatment should always be given preference; on the other hand, many surgeons are equally convinced that operation, skillfully performed, offers the safer and surer means of recovery. Skill in either method no doubt gives fair promise of success. There are three types of ulcer for which the patient should probably always be subjected to operation: the ulcer of three or more years' duration, especially the old calloused ulcer which produces obstruction; the ulcer of the elderly patient or the very large ulcer which cannot be absolved of the suspicion of being carcinomatous; and the ulcer which shows a persistent tendency to bleed. In uncomplicated simple ulcer of relative short duration in youthful people, I strongly believe that medical treatment with prolonged rigid dietary control should always be the procedure of choice.

Treatment.—Before dietetic treatment is instituted, it is essential that all foci of infection be removed. Pyorrhea should be cured or kept under control, dental decay repaired, teeth with apical abscesses extracted and diseased tonsils removed. The use of alcohol and tobacco should be stopped.

The objects of treatment are: (1) rest for the stomach, both motor and secretory, and (2) adequate nourishment for the patient. This second objective is difficult to attain, especially in the earlier weeks of treatment, but it should never be lost sight of.

Rest in bed is the best means for insuring rest of the stomach; if feasible, it should be insisted on during the first three weeks of treatment. It is of distinct advantage during this period to have the patient in a hospital or nursing home, for the discipline and morale of an institution helps in the subsequent treatment. Occasionally the patient cannot go to bed without prohibitive financial sacrifice. In such a case, especially if the ulcer is of brief duration, it is proper to permit him to continue his ordinary occupation, but good control should be maintained of his daily life, particularly as to the extent of his exercise and the amount of his rest. Exercise should be limited to that essential to his daily duties, and he should be required to lie down an hour each day after the mid-day meal. Ambulatory treatment is a makeshift, but if carefully supervised it frequently gives good results.

Individualization is always advisable. It is unfortunate that the proponents of the various dietary plans which have been devised insist as a rule that they be followed slavishly. Most of these methods of treatment are good in principle, but they are not so good that they can be applied unchanged to every case; for any method, no matter how meritorius, must be modified occasionally to meet the needs of the individual.

Diet in Gastric Ulcer.—Certain articles of diet are of especial value in the treatment of peptic ulcer. Milk always comes first. It should be the sole food in the beginning, the mainstay of the diet as treatment proceeds, and an important adjunct to the menu for many years after the "cure" has been completed. To the milk may be added cream in varying proportions up to one-half the volume. Many patients, however, cannot comfortably take such a rich mixture and a few should be given merely whole milk. For variety's sake and to give the milk flavor, substances such as cocoa and coffee are often added. In my experience, however, it is best to give the milk straight without effort at camouflage. Eggs rank next to milk. They may be taken raw, soft boiled or poached; from three to six daily are usually given. Next in importance come the cooked cereals, oatmeal, farina, cream of wheat, etc., in which category should be included also milk toast, mashed potatoes and rice. Stewed and preserved fruits with zwieback or dry toast (good mastication) may also be given. Orange juice and other fruit juices are permissible in the later weeks of treatment. Last in the scale of permitted foods come tender meats, fish and the simpler desserts, such as rice or tapioca pudding.

The criticism has been offered that because of the lack of leafy vegetables the foods permitted in the ulcer regimen are deficient in vitamins, mineral elements and roughage. The answer is that vitamins and minerals are supplied in fair measure by the milk and orange juice, and that the period of rigid dietary restriction is so brief that vitamin or mineral shortage will not be seriously felt. Lack of roughage may result in constipation, but as a rule this is prevented by the addition of magnesia to the alkaline powders. The further addition of plain agar to the diet will give to the intestinal contents the necessary bulk and consistency and thus prevent constipation, which can be done without injury to the ulcer. It is better to depend on agar than on magnesia to counterbalance the constipating influence of the diet.

Many foods should be prohibited in ulcer. These include: broths and all meat soups, dried or smoked meats and those with tough fiber, coarse vegetables, raw fruits, piquant sauces and other highly seasoned foods and all alcoholic drinks.

Nutrient enemas have been widely used to spare the stomach, particularly after hemorrhage. Elaborate mixtures containing milk, eggs and other foods have been devised, but the formulas for these are not given here because it has been definitely shown that they are valueless except for their content of water and glucose. When it is desired to nourish the patient by rectum, it is best to give, by the Murphy drip method, plain tap water or physiologic salt solution, to which has been added dextrose (or corn syrup) in the strength of from 5 to 10 per cent. From 1 to 2 liters a day may be given in this manner.

To insure gastric rest, it is advisable to insist on intestinal rest also. Laxatives should be avoided, and if it is necessary to cleanse the lower bowel in order to give fluids by rectum, only small cleansing enemas should be used—never the so-called high enema.

Alkalitherapy is intimately related to the dietary regulation of ulcer. This will be discussed more fully in connection with the Sippy treatment. Bismuth subcarbonate is frequently combined with the alkalis. It has been suggested that bismuth acts mechanically by giving a protecting coat to the ulcer; but since the ulcer cannot be located in the roentgenogram by such a coating, this manner of action is questioned. Bismuth or barium taken in the contrast meal for roentgenography will often give prompt relief from pain. A teaspoonful of bismuth taken in a glass of buttermilk one-half hour before the first feeding in the morning will sometimes add greatly to the patient's comfort and apparently promote healing.

Ulcer Cures.—The ulcer cures which have been devised are numerous. The classical treatment for many years was that of von Leube; within ten years this clinician himself treated more than 1,000 patients by this method. This was superseded in popularity in 1904 by the diet of Lenhartz, which contains more albumen and is of higher caloric value. Numerous modifications of the Lenhartz treatment have been devised, the best of which is the regimen of Sippy. The two earlier cures will be mentioned briefly, and that of Sippy given in detail.

Von Leube's[8] *regime* included not only carefully planned dietary regulation, but also rest in bed, a morning drink of Carlsbad water and hot applications to the abdomen. His cure was divided into four periods, during the first part of which the patient was fed every two hours. The diet of the first period was limited to boiled milk, bouillon, strained barley water, predigested foods (Sanatogen, Somatose) beef extract and zwieback or crackers. The second diet, which was begun after about ten days, included all of the foods mentioned above, to which were added gruels, rice, farina, soft eggs, calves' brains, squab and tender chicken. At the end of another week, on the seventeenth or eighteenth day, the third diet was started; this merely contained in addition finely sliced raw ham, beef steak, potatoes and tea or coffee. The fourth diet, which was begun about the twenty-fourth day, permitted feedings at somewhat longer intervals, and included in addition to the food enumerated above, broiled chicken or squab, roast beef, venison, macaroni and ordinary white breads. During this last period the patient received about five meals daily. Following this, vegetables were permitted. Dietary supervision was maintained for a period of six months.

Lenhartz's Diet.—Lenhartz,[9] in devising his diet, was actuated in a measure by the desire to obviate the undernutrition which was an inevitable part of the Leube treatment. He immediately gave food to his patients who were suffering from ulcer, without any preliminary starvation period, even though a hemorrhage had occurred the previous day. Milk and eggs were the foods first permitted, and then other articles were gradually added. In his endeavor to prevent all intestinal activity he encouraged constipation, even to the extent of permitting the patient to go several days without a bowel movement.

TABLE 1.—*The Lenhartz Diet*

	Days after Last Gastric Hemorrhage													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Eggs	2	3	4	5	6	7	8	8	8	8	8	8	8	8
Sugar with egg	...	...	20	20	30	30	40	40	50	50	50	50	50	50
Milk	200	300	400	500	600	700	800 twice	900 twice	1,000 twice	1,000 twice	1,000 twice	1,000 twice	1,000 twice	1,000 twice
Scraped beef	...	...	...	...	...	35	35	35	35	35	35	35	35	35
Milk and rice	...	...	...	...	...	100	100	200	200	300	300	300	300	400
Zwieback	...	...	...	...	...	.....	.....	20	40	40	60	60	80	100
Raw ham	...	...	...	...	...	.....	.....	.....	.....	50	50	50	50	50
Butter	...	...	...	...	...	.....	.....	.....	.....	20	40	40	40	40
Calories	280	420	637	777	955	1,135	1,588	1,721	2,138	2,478	2,941	2,941	3,007	3,073

Sippy Treatment.—In 1915, Sippy[10] proposed a method of treatment which he had then used for more than twelve years with results "far beyond early expectations." His regimen in its various modifications is by far the most widely used method of ulcer treatment. He reasoned that the failure of the ulcer to heal was due to the digestive action of the gastric juice and that neutralization or removal of the hydrochloric acid would prevent this action. His treatment therefore includes not only rest and rigid dietary control, but also gastric lavage and the use of large amounts of alkali. The endeavor is to render the digestive action of the gastric juices inert during the entire period when the food and the accompanying secretion are in the stomach; that is, from 7 a. m. to 10:00 p. m. In the beginning, the stomach tube is passed each evening at bedtime to determine whether there is an excessive night secretion, such as accompanies pyloric obstruction. If the gastric contents exceed the normal quantity of about 10 cc., the stomach is washed out, and this is repeated each night until evidences of obstruction disappear and the irritative secretory activity has subsided Sippy laid great emphasis on the importance of this procedure.

The patient should as a rule remain in bed from three to four weeks.

Feeding is begun immediately without any preliminary starvation period. The plan of diet which Sippy found most adaptable was given by him as follows:

> Three ounces of a mixture of equal parts milk and cream are given every hour from 7 a. m. until 7 p. m. After two or three days soft eggs and well-cooked cereals are gradually added, until at the end of about ten days the patient is receiving approximately the following nourishment: 3 ounces of the milk and cream mixture every hour from 7 a. m. until 7 p. m. and in addition, three soft eggs, one at a time, and 9 ounces of a cereal, 3 ounces at one feeding, may be given each day. The cereal is measured after it is prepared.
>
> Cream soups of various kinds, vegetable purees and other soft foods, may be substituted now and then, as desired. The total bulk at any one feeding while food is taken every hour should not exceed 6 ounces. Many of the feedings will not equal that quantity. The patient should be weighed. If desired, a sufficient quantity of food may be given to cause a gain of two or three pounds each week.
>
> A large variety of soft and palatable foods may be used, such as jellies, marmalades, custards, creams, etc. The basis of the diet, however, should be milk, cream, eggs, cereals and vegetable purees. Lean meat is not given during the period of accurate observation, since it interferes with the tests for occult blood in the stool and aspirated stomach contents.
>
> The acidity is more easily controlled by feeding every hour and giving the alkalies midway between feedings. The acidity may, however, be controlled by feeding every two, three and four hours. I have maintained complete control of the free hydrochloric acidity in several cases by feeding three times daily. In most cases, however, the plan of feeding every hour is best.

Neutralization of the hydrochloric acid is best accomplished, according to Sippy, by the administration of one of the following alkaline powders every hour between feedings:

Powder No. 1

	Grains
Sodium bicarbonate	10
Heavy calcined magnesia	10

Powder No. 2

Sodium bicarbonate	20
Calcium carbonate	20

These powders may be alternated, or they may be otherwise varied, as the circumstances demand. Powder No. 1 is laxative and therefore cannot be given without limit. Accurate information concerning the reaction of the gastric contents should, according to the author of the treatment, be obtained from time to time by means of the stomach tube. The contents should at first be withdrawn at different hours on successive days until the necessary alkali dosage has been definitely determined. Sippy stated: "It is not difficult to determine the amount of alkali required between feedings to control accurately all free acidity. If not controlled the first few days by giving the usual amount, then the dose is gradually increased until the acidity is regularly found controlled."

It should be added here that the necessity for neutralizing the gastric contents is questioned by Crohn and Reiss,[11] who, after careful investigation, state that clinical improvement as a result of medical treatment can take place independently of whether the hyperacidity is relieved or whether the case remains acid-fast. In fact, these investigators found that only a small percentage of their patients who were relieved show a reduction in the acid produced during digestion. Their results seem to justify the conclusion that clinical relief follows improved regulation of gastric motility. They write: "There are no instances of clinical cure that could be solely attributed to reduced acid secretion when delayed motility was present as a complicating factor. Unless relief is had from the pylorospasm we fail to note the disappearance of subjective symptoms." They emphasize the close relationship between subjective pain and exaggerated peristalsis. They also call attention to the importance of psychic influences, and state that a patient who is unhappy during the treatment is not likely to get well.

DIETARY ROUTINE USED BY THE AUTHOR (SIPPY METHOD)

First Week.

First 2 Days:

6 tbsp. (3 ounces), whole milk 2 parts—cream 1 part, every hour 7 a. m. until 9 p. m.

Next 5 Days:

7:00 a. m.: 3 ounces milk and cream mixture
8:00: 3 ounces milk and cream mixture
9:00: 3 ounces milk and cream mixture and 6 tbsp. strained oatmeal with cream
10:00: 3 ounces milk and cream mixture
11:00: 3 ounces milk and cream mixture
12:00 3 ounces milk and cream mixture
1:00: p. m. 3 ounces milk and cream mixture and 1 raw egg
2:00: 3 ounces milk and cream mixture
3:00: 3 ounces milk and cream mixture
4:00: 3 ounces milk and cream mixture
5:00: 3 ounces milk and cream mixture and 1 raw egg
6:00: 3 ounces milk and cream mixture
7:00: 3 ounces milk and cream mixture
8:00: 3 ounces milk and cream mixture
9:00: 3 ounces milk and cream mixture

Second Week.

First 3 Days:

7:00 a. m.: 3 ounces milk and cream mixture
8:00: 3 ounces milk and cream mixture and 6 tbsp. strained oatmeal with cream
9:00: 3 ounces milk and cream mixture

10:00: 3 ounces milk and cream mixture and 1 soft boiled egg
11:00: 3 ounces milk and cream mixture
12:00: 3 ounces milk and cream mixture and 1 raw egg
1:00 p. m.: 3 ounces milk and cream mixture
2:00: 3 ounces milk and cream mixture and 1 soft boiled egg
3:00: 3 ounces milk and cream mixture
4:00: 3 ounces milk and cream mixture and 6 tbsp. thin cream of wheat with cream
5:00: 3 ounces milk and cream mixture
6:00: 3 ounces milk and cream mixture and 1 soft boiled egg
7:00: 3 ounces milk and cream mixture
8:00: 3 ounces milk and cream mixture and 1 raw egg

Next 4 Days:

Same as above, except that a small slice of toast with butter is added at 11 a. m. and 1, 3, and 5 p. m.

THIRD WEEK.

7:00 a. m.: Juice of one orange, strained oatmeal with cream
1 slice toast, 6 ounces milk and cream
9:00: 1 soft boiled egg, 1 slice toast, 1 tsp. preserves
6 ounces milk and cream
11:00: 1 raw egg with 6 ounces milk and cream
1:00 p. m.: 1 spoon mashed potato with butter, 1 slice toast with butter
6 ounces milk and cream
3:00: Tapioca pudding with cream, 1 slice toast; 1 soft boiled egg
6 ounces milk and cream
5:00: 1 egg with milk, prune souffle, 1 slice toast with butter
7:00: Cream of wheat with butter
Apple sauce, 6 ounces milk and cream
9:00: 1 coddled or soft boiled egg, 1 slice toast
6 ounces milk and cream
10:00: ½ glass orange juice

FOURTH WEEK.

6:00 a. m.: ½ glass orange juice
7:00: 7 ounces milk and cream

BREAKFAST:

8:30: Well cooked cereal with sugar and cream
1 spoon apple sauce
1 poached egg on toast
Glass milk and cream
11:00: Glass milk and cream
12:30 p. m.: Oysters (panned, creamed or raw) or very tender meat or fish
Baked or mashed potato with butter; toast
Tapioca pudding with cream
Glass milk and cream
3:00: Glass milk and cream
5:00: Glass milk and cream
Toast with butter and preserves
6:30: Soft boiled egg, cream of wheat with butter
2 slices toast
Rice pudding (no raisins) with cream
Glass milk and cream
9:00: 1 glass milk and cream, orange Jello with cream, or small well baked apple without core or skin

The following *details* are pertinent to the dietary management of ulcer. On the patient's bedside table should be placed: (*a*) a thermos bottle containing the milk and cream mixture, (*b*) a measuring glass, (*c*) a clock, (*d*) a supply of powders 1 and 2, and (*e*) drinking water with a glass. He is instructed, beginning at 7 a. m. and continuing until 7 p. m., to take each hour on the hour 3 ounces of the milk and cream mixture, and between each feeding, on the half hour, one of the powders. The nurse must wash the measuring glass with reasonable promptness after use, but on the patient himself rests the burden of taking at the proper time both food and medicine. After a few days the other foods permitted may be added, but these are to be served at regular intervals and on an attractively arranged tray. Some effort should be made to relieve the monotony of this regimen.

The *results* reported by Sippy even in long standing cases of pronounced pyloric obstruction, were wonderfully satisfactory. It is the standard medical treatment today. It presents, however, two objectionable features: the half hourly taking of food and medicine quickly becomes tiresome, and the large amounts of alkali administered may be harmful. It is not invariably necessary, however, to feed at such frequent intervals or to give large amounts of alkali. I have found, too, that a half and half mixture of milk and cream is not universally well borne. Often it is advisable to reduce the cream to one third or even to omit it altogether. In many cases, instead of 3 ounces of milk hourly, it is proper to prescribe 6 ounces every two hours.

This brings us again to the question of individualization. The Sippy cure is the best form of medical treatment, but the physician must accept it merely as a guide, and should construct each patient's diet according to his individual needs. The following is a specimen of the dietary instructions, based on the Sippy treatment, which I have found useful: these are varied according to circumstances.

Instructions for the Patient

1. During the first three weeks remain in bed the entire time, getting up only to go to the toilet. During the fourth week, get up for a part of each day, gradually lengthening the time out of bed.

2. *First Week:*

Take every hour, from 7 a. m. to 9 p. m., 3 ounces of a milk and cream mixture (whole milk two parts and cream one part). For this purpose keep this mixture cold in a thermos bottle or place the vessel containing it in a bucket of ice beside your bed, and place at your bedside a watch and a 3 ounce measuring glass. After two days, add daily two raw eggs and one dish of cooked cereal with cream. Each of these articles should be taken with the milk at a regular feeding time, preferably cereal in the morning and one egg at noon and at night.

3. *Second Week:*

Three additional eggs (raw or soft boiled) and an additional dish of cereal may be taken, thus giving five eggs and two helpings of cereal daily.

After three days, four slices of toast with butter daily may be added.

4. *Third Week:*

The amount of the toast should be increased. Preserves, honey, marmalade, and stewed fruits may be added; also rice, mashed potatoes, and the simpler desserts, such as rice or tapioca pudding, prune souffle, etc. Orange juice twice daily.

5. *Fourth Week:*

Take the milk and cream mixture, a glassful every two hours. The other articles of diet permitted may be taken three times daily at regular meal times. Any tender meat or fish once daily may be taken; if this is done, the number of eggs should be reduced to two. Any of the simpler vegetables may be gradually added to the diet.

6. One powder should be taken every hour on the half hour; this is to be changed as circumstances demand.

An Ambulant Form of Treatment.—This form of treatment has been recommended by Alvarez[12] for duodenal ulcer. He recognizes that the ever present danger of malignant degeneration places gastric ulcer in a different category and in most instances demands for it surgical intervention. This does not obtain in duodenal ulcer. He states: "The Sippy Diet is not to be despised; it works; but it is too elaborate for the general practitioner and his poorer and more ignorant patients. It calls for (1) constant faith and training on the part of the physician; (2) a hospital with excellent internes; and (3) a patient who has plenty of time and money to spend on his cure." Because of these objections he has devised his ambulant treatment for duodenal ulcer.

He permits the patient to remain at work and advises as the basis of treatment three good meals daily with feedings at stated intervals between times. The food for the meals is chosen from his "Smooth Diet" list. For the between feedings a mixture containing a quart of milk, two eggs, and perhaps a half pint of cream is placed in a thermos bottle, which the patient takes with him to work. If milk is not well borne, thin cereal gruels may be substituted. Robinson's Scotch groats and Robinson's barley flour are both good. Assuming that the patient eats three good meals daily, at 7:30 a. m., 12 and 6 p. m., he then takes between meals at 10 a. m. and to 2, 4, 8 and 10 p. m. a glassful (6 ounces) of the milk and egg mixture. Another glassful may be taken if he awakens during the night. If this mixture is not available, a milk shake or malted milk at the soda fountain may be substituted.

For patients whose pain is likely to recur within a short time, say an hour and a half, Alvarez advises that a different schedule be substituted, and that they take the mixture at intervals of one and one-fourth hours. He feels, however, that severe cases such as these as a rule demand surgical treatment.

The patients are asked to do as little hard work as possible, and are told especially to refrain from lifting, gardening, "the daily dozen" and even golf. Walking is the only exercise encouraged.

Alvarez has seen prompt relief follow the institution of this regimen, and he believes that by means of it the majority of patients will in the course of time apparently be cured, although he uses the word "cure" cautiously. He insists that they observe these directions for six months or a year, and that they continue always to take some food between the regular meals.

SMOOTH DIET LIST* (ALVAREZ)

Choose from the following:

Breakfast:

Orange juice; grape fruit (avoid the fiber).

Cantaloupe and melons are inadvisable as they tend to regurgitate for hours.

Coffee in moderation; chocolate; cocoa or tea.

One or two eggs with ham or bacon (avoid the purely fibrous part).

White bread and butter; toast or zwieback.

Any smooth mush, such as farina; cream of wheat; cornmeal or strained rolled oats.

Puffed cereals and corn flakes are also allowed.

Shredded wheat biscuits and other coarse breakfast foods are not allowed.

Lunch or Dinner:

Broths; bouillon; cream soups; chowder.

Small portion of meat, fish, oysters, chicken or squab (avoid the fibrous parts and gristle).

No smoked or canned fishes, or pork.

Avoid veal, crab and lobster if they seem to cause indigestion.

White bread and butter; hot biscuits made small so as to consist mainly of crust. No rough branny breads or bran biscuits.

Rice; potatoes—baked, mashed, hashed-brown or French-fried; sweet potatoes; hominy; tomatoes stewed, strained and with cracker crumbs; well cooked cauliflower tops with cream sauce; and asparagus tips. Later may try brussels sprouts. Italian pastes; noodles, macaroni or spaghetti, cooked soft with a little cheese or cream sauce.

Purees of peas; beans; lentils; lima beans or artichoke hearts. All skins or fiber should be removed by passing through a ricer. "Cornlet" in cans furnishes sweet corn without the indigestible husks. There are practically no other vegetables that can be pureed to advantage. Spinach often causes trouble and is not recommended. Bananas can be fried in butter or baked in their skins. String beans are allowed if young and tender. No salads at first. Later you may try a little tender lettuce with apples or bananas, tomato jelly or boiled egg. Mayonnaise and French dressing are allowed.

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* This diet is taken from Alvarez, W. C.: The Mechanics of the Digestive Tract, New York, Paul B. Hoeber, 1922, p. 111.

For Dessert:

Simple puddings, custards, ice-cream, jello, plain cake, canned or stewed fruit. Avoid cheese, nuts and raisins.

If constipated, stewed fruit may be taken once or twice a day. In winter, the dried pared fruit may be used for stewing. Too much sugar should not be added. Apple sauce is much more palatable if made from unpared and uncored apples. The sauce is strained later. It may be diluted with a little tapioca or sago. The apples may be baked. Blackberries and loganberries can be stewed and strained, and the sweetened juice thickened with cornstarch. This makes a delicious dish with the full flavor of the berries. Canned fruits, such as pears and peaches, are allowed. Later you may try a fully ripe pear, peach or apple.

Avoid most of the green vegetables, salads and raw fruits.

Avoid sugar in concentrated form; take no candy or other food between meals.

Avoid eating in a rush or when mentally distraught.

Treatment in Hemorrhage from the Stomach.—The immediate outlook during hemorrhage is seldom as bad as it usually appears. Fatal hemorrhage is rare; death occurs in probably less than 3 per cent of manifest hemorrhages. The anemia which follows may be of serious moment, for it may eventually increase the hazards of the illness. The fact that hemorrhage is occasionally followed by apparent improvement with relief from all symptoms has been the subject of frequent comment.

Complete rest, both general and alimentary, is essential. The patient must be kept in bed, preferably on his back, and should not be permitted to get up for any purpose; this enforced rest should continue at least ten days after the hemorrhage has ceased. Everything which might raise blood pressure should be avoided, in which are included not only physical effort but also disturbing emotions; fears should as far as possible be allayed and the patient's equanimity restored. To accomplish this as well as to stop peristalsis, it is usually advisable to give morphine.

In manifest hemorrhage no food should be given for several days after the bleeding has ceased. This is regarded as debatable by a few physicians who, following Lenhartz, feel that it is safe to give raw eggs and milk on the day after the hemorrhage. It is wiser, however, I feel sure, to withhold food and to permit the ingestion of only a little water or cracked ice by mouth. Adequate amounts of fluid, say from 1 to 2 liters, may be given per rectum by the Murphy drip method; to this may be added 5 per cent glucose. Should the hemorrhage persist or show a tendency to recur, it may be necessary to omit even this; for rectal injection frequently causes peristaltic unrest of the stomach. Two or three days after cessation of the hemorrhage, feeding should begin, preferably somewhat after the scheme outlined by Lenhartz.

Gastric lavage has been successfully used for the control of gastric hemorrhage. Its benefit is in the removal of fermenting débris and the possible dislodgment of a partially occluding thrombus which prevents closure of the bleeding vessel. Both very cold and very hot water has been advised. The danger of thrusting the stomach tube through the ulcer during lavage and causing perforation is not as great as is sometimes feared.

The use of drugs for the control of hemorrhage cannot be discussed in this book, but three brief comments seem admissable. Heart tonics, so called, and other stimulants are bad; morphine is excellent, and bismuth (or barium) is sometimes of value.

TUBERCULOSIS OF THE STOMACH

Tuberculosis of the stomach is rare. Simple gastritis as an accompaniment of pulmonary tuberculosis is common, but actual tuberculous involvement does not often occur. There are three forms in which this disease may appear: (1) ulcer, which cannot be distinguished clinically from simple ulcer; (2) tuberculous gastritis with diffuse involvement chiefly of the submucosa, leading to thickening of the wall and perhaps obstruction at the pylorus; and (3) hypertrophic thickening of the gastric wall simulating cancer. The recognition of tuberculosis elsewhere and the roentgenologic signs must all be considered carefully.

The treatment should be medical not surgical, for these patients do not stand operation well, and healing after surgical interference is always difficult. The dietary regulation should depend in large measure on the seat and extent of the tuberculous involvement. In the first type mentioned above, the usual ulcer regimen is suitable; in the second and third types, the diet recommended for chronic gastritis is best. In every case effort should be made to give as much nourishing food as possible. Additional hygienic measures, such as rest and exposure of the abdomen to the direct rays of the sun, should also be used.

SYPHILIS OF THE STOMACH

Syphilis of the stomach may occur at almost any stage in the course of a syphilitic infection. It may appear as: (1) a diffuse fibrous hyperplasia of the entire stomach wall, leading to thickening and marked narrowing of the lumen; or (2) as a localized gumma giving the appearance of a tumor. Both of these forms of syphilis are difficult of recognition, for in their clinical course, physical signs, and roentgenologic appearances both may simulate closely gastric ulcer or cancer.

A history of syphilis and a positive Wassermann reaction may be the only signs which indicate the true nature of the disease, and at times only the therapeutic test will decide the question. The treatment of syphilis of the stomach is simple; adequate antisyphilitic medication and the type of diet advised for chronic gastritis are required.

CANCER OF THE STOMACH

The origin of the malignant tumor is as much a mystery as ever. Individual predisposition, the result of heredity, no doubt plays a predominating rôle, but just how the predisposed person acquires the disease and what other factors are of contributory influence, it is difficult to say. Mechanical insult and chemical irritation are probably contributory factors, for carcinoma of the stomach seems most likely to develop in a location where such insults are prone to occur or where some other lesion has already existed. It has been suggested that the stomach is at times the seat of "precarcinomatous" disturbances which may later lead to true cancer, and that the great incidence of this disease in persons who have previously appeared healthy can be explained on the ground that minor lesions of the stomach are frequently overlooked. Among such "precarcinomatous" lesions, ulcer is believed to rank first and after this mucous polyp and the atrophic changes in the mucosa which lead to achylia gastrica. According to the adherents to this view, a painstaking scrutiny of the past history will give evidence of the existence of such diseases in a surprisingly large number of cases.[13] To prove the truth of this theory is difficult. At present there is only one etiologic factor in cancer of the stomach of which we can feel reasonably sure; that is, an inherited predisposition.

The tragedy of carcinoma, as has been aptly said, lies in the fact that in the majority of cases no symptoms appear within the first few months, and the disease is thus permitted to progress unrecognized. The extent of the tragedy, however, can be lessened somewhat by the maintenance of a continuous lookout. If anything is to be done, the disease must be recognized early. Persistent anorexia or even abdominal discomfort related to the taking of food in a middle-aged patient who has never before had digestive disturbance is always suggestive of carcinoma. Lack of appetite may for months be the only symptom, particularly if the tumor is limited to the fundus. Especially significant is continued loss of weight in spite of the taking of a sufficient amount of food. Vomiting is usually a late symptom which gives evidence of pyloric obstruction; the disease should be recognized before this stage has been reached.

This is not the place for a discussion of the physical changes, the roentgenological appearances or the laboratory findings of carcinoma of the stomach. If much is to be accomplished, diagnosis should be made before the appearance of a palpable tumor. Too much reliance should not be placed on the examination of the stomach contents. Free hydrochloric acid is as a rule missing, particularly when the tumor is in the fundus; but not infrequently, especially in the earlier stages, this acid may be present even in increased amounts. Lactic acid and other evidences of fermentation tell merely of stasis of the stomach contents. The persistence of occult blood in the feces when there has been no meat in the diet is always suggestive. The roentgenogram and the fluoroscope when used by a person experienced in this work will usually give satisfactory evidence; in advanced cases the picture of cancer is as a rule unmistakable. On the other hand, syphilis and tuberculosis of the stomach may give appearances which cannot be distinguished roentgenologically from carcinoma. There is no short cut to the diagnosis of carcinoma of the stomach. Alertness and vigilance are essential for early recognition. To distinguish a cancer without tumor from other diseases of the stomach, especially from atrophy on the one hand and from the gastric neuroses on the other, often requires painstaking clinical scrutiny and good judgment; a careful weighing of all possible evidence is necessary.

Dietary Regulation.—Such regulation will often add to the patient's comfort, but operation is the only form of treatment which promises definite improvement. It is unfortunate that in so many cases the disease is first recognized when it is too late; for skilful surgery combined with subsequent radiotherapy when undertaken reasonably early will add much to the comfort of the patient and perhaps greatly prolong his life. Operation is advisable when it is possible with fair promise of success to remove the tumor or to relieve an obstruction. It is inadvisable when the anemia is grave, when there are metastases in the liver or other organs, or when advanced age and great weakness add materially to the hazard of the undertaking.

The dietary treatment of carcinoma of the stomach is to be undertaken when for the reasons above given operation is inadvisable, or in order to promote comfort and insure adequate nourishment after operation. The location of the cancer and the nature of the functional disturbance caused by it should determine in some measure the dietary regimen. When depression of gastric secretion is a salient feature, the type of diet suitable for achylia gastrica is best (page 523); when increased secretory activity is evident, as sometimes occurs with a cancer which has developed on the site of an old ulcer, a diet rich in proteins, such as is advised for irritative gastric disorders, is proper; when pyloric obstruction and loss of motor power dominate, the dietary program recommended for gastric ectasia is suitable (page 529). In general it can be said that the same food and the same dietary precautions which were advised above for chronic gastritis, with due regard for the nature of the secretory disturbance, should be prescribed in carcinoma of the stomach. One of the handicaps of the patient with the latter disease is always a concurrent gastritis.

Invariably the diet should be simple, easily digested and rich in albumen. Milk is the best food and should be given in relatively large quantities. Soft boiled eggs and finely divided tender meats are also suitable. Gruels, toast, zwieback and preserves should be prescribed. Cream and butter are well borne and add to the energy of the diet; other fats should as a rule be avoided. Coarse bulky vegetables should not be eaten except in the form of purees. The feedings should be small in amount and at frequent intervals, say five or six daily. Care should be taken, especially when there is pyloric obstruction, never to overload the stomach either with food or water.

Lack of appetite and actual distaste for food must often be combated. It is essential that the food be made as appetizing as possible and that it be of sufficient variety. Tea, coffee and the weaker alcoholic drinks may be of help. While it is important to prescribe such foods as will presumably add to the patient's comfort and improve the state of his nutrition, it is well to bear in mind that his days are numbered and that his life should not be made miserable by unnecessarily strict dietary regulation. His tastes and inclinations, unless distinctly harmful, should be given wide play.

Lavage.—This will often add greatly to the patient's comfort and the state of his nutrition. It is of especial value when there is obstruction leading to stagnation and fermentation; irritating material is removed, and there results not only relief from pain and discomfort, but also increased secretory activity with better appetite and digestion. Lavage is frequently given in the morning before breakfast, but in order to relieve pain and permit sleep it is sometimes best done at bedtime.

IRRITATIVE SECRETORY ACTIVITY

Hyperchlorhydria.—This is not a disease entity. It is a clinical syndrome in which there is both gastric hypersecretion and epigastric distress; both must be present to warrant the designation hyperchlorhydria. Increased gastric acidity is not incompatible with health and comfort. It is now known that the gastric juice is normally excreted in much higher concentration than appears on clinical examination, and that it undergoes subsequent neutralization, probably by means of regurgitated bile. On the basis of numerous fractional determinations of gastric acidity Rehfuss[14] states: "Studies of healthy men indicate that there is no acidity in disease which can not be encountered in health." The exact titer of the gastric juice is, I am satisfied, not a matter of great moment; its importance has been greatly exaggerated.

Stimulation of the gastric mucosa either direct or indirect may lead to increased secretory activity, and the suggestion has been made that this response is not necessarily always the same, that in its reaction the stomach will at times secrete a small amount of concentrated fluid of high acidity and at other times a more dilute fluid which is excessive in amount. The former reaction will lead to what is called hyperacidity; the latter to gastro-succorrhoea. Just what part motor influences play here it is difficult to say; in many instances they unquestionably play a predominating rôle and are in themselves responsible for the discomfort of which the patient complains.

Hyperchlorhydria is believed to accompany the widest variety of abnormal states: chlorosis, the climateric, disease of the pelvic organs, faulty dietary habits, especially an excessive protein intake or the use of too much tea or coffee, constipation and various abdominal diseases. The existence of a purely functional disturbance without organic basis, manifested by heart burn, acid eructations and gastric juice of high acidity, is a matter of question. Many authors believe that this syndrome is a frequent accompaniment of nervous disturbances, such as vagotonia and emotional imbalance. Others believe that it represents always some organic disease within the abdomen, such as peptic ulcer, appendicitis or cholecystitis. The extreme view was reached by Moynihan who stated that constantly recurring hyperacidity always means duodenal ulcer. My own experience leads me to believe that the vast majority of (I am tempted to say all) patients with the clinical syndrome called hyperchlorhydria actually suffer with ulcer.[15]

This discussion is entered into in order to explain the fallacy of the so-called hyperchlorhydria diet. For the majority of patients of this group the ulcer regimen (see page 507), more or less modified, presents the proper diet. Many of them are promptly relieved when given a bland, nonstimulating diet such as is used for ulcer. At the risk of repetition, the following rules are suggested: Exercise should be limited, excitement prohibited, and as much rest as possible with reasonable recreation insisted on. Alkalis in the form of milk of magnesia, or any of the alkali powders above recommended for ulcer, should be given one hour after meals, perhaps oftener. Feedings should be at frequent intervals, say about five times daily; three fairly full meals with two small interval feedings. The following foods may be permitted:

Milk (1 quart daily) buttermilk, clabber, cocoa.

Cereals with cream, mashed potatoes, rice with butter, milk toast, dry toast, zwieback.

Eggs, raw, soft-boiled or poached (4 to 6 daily).

Baked fish (without the skin), raw or stewed oysters; later, a little tender meat of any kind except pork.

Stewed or baked apple without the core, orange juice and other fruit juices.

Rice or tapioca pudding; cup custard, jellies.

MENUS FOR PATIENTS WITH IRRITATIVE SECRETORY ACTIVITY

I.

7:00 a. m.:	½ glass orange juice
Breakfast:	Average helping well cooked cereal with cream and sugar
	Soft boiled egg
	Dry toast, butter, cocoa
10:00 a. m.:	Baked apple (no core or skin) with cream, glass milk
Dinner:	6 creamed oysters on toast
	A. h. mashed potatoes
	Dry toast, butter
	A. h. baked egg custard, glass milk
4:00 p. m.	A. h. cream of wheat with cream and sugar
	1 raw egg
Supper:	A. h. oatmeal with cream and sugar or butter
	1 poached egg on toast
	A. h. tapioca cream
	2 toast, milk
Bedtime:	Milk shake

II.

6:00–7:00 a. m.:	½ glass fruit juice
Breakfast:	A. h. Farina with cream and sugar
	Milk toast
	1 shirred (soft) egg
	1 cup cocoa
10:00 a. m.:	1 glass milk and egg shake
Dinner:	Small serving baked white fish (no skin)
	A. h. creamed potatoes, zwieback, butter
	A. h. floating island
	1 glass milk
4:00 p. m.:	1 glass buttermilk or clabber with toast
Supper:	2 soft boiled eggs, rice with butter
	2 slices toast, butter
	A. h. Spanish cream with whipped cream
	1 glass milk
Bedtime:	Milk and egg shake

III.

6:00–7:00 a. m.: ½ glass orange juice
Breakfast: A. h. cream of wheat with cream and sugar
2 soft boiled or coddled eggs
2 toast, butter, jelly
1 cup cocoa
10:00 a. m.: Baked or stewed apple, glass milk
Dinner: 6 raw or cooked oysters
Baked potato
2 slices toast, butter
1 egg rice custard
1 glass milk
4:00 p. m.: Bowl Junket
Toast and butter
Supper: 2 soft poached eggs on hot mashed potatoes
Zwieback, Spanish cream, glass milk
Bedtime: Milk and egg shake

IV.

6:00–7:00 a. m.: ½ glass orange juice
Breakfast: A. h. oatmeal strained with cream and sugar
2 shirred (soft) eggs
Toast, butter, jelly
1 cup cocoa
10:00 a. m.: Milk and egg shake
Dinner: 6 panned oysters on toast
A. h. mashed potatoes, toast, butter
A. h. apple tapioca pudding with cream
1 glass milk
4:00 p. m.: 1 raw egg, glass clabber
Supper: 1 soft boiled egg
A. h. rice with butter, toast, butter
A. h. Floating Island
1 glass milk
Bedtime: Baked apple, glass milk, toast if desired

V.

6:00–7:00 a. m.: Orange juice
Breakfast: A. h. strained well cooked pettyjohn, cream and sugar
1 soft boiled egg, toast, butter, jelly
1 cup cocoa
10:00 a. m.: Egg and milk shake
Dinner: 6 creamed oysters on toast or oyster stew
Baked potato
Cup boiled custard
Toast, butter, milk
4:00 p. m.: 1 raw egg, toast, butter, jelly
Clabber
Supper: 2 soft scrambled eggs
A. h. cream of wheat with butter
A. h. rice pudding
2 slices toast, butter, milk
Bedtime: Milk and egg shake

Gastrosuccorrhea.—Gastrosuccorrhea (Reichmann's disease) is a symptom complex which properly belongs with hyperchlorhydria. The excessive flow of gastric juice may occur in three forms: (*a*) continuous, (*b*) only when food is taken (digestive) and (*c*) intermittently. It is merely one evidence of disturbance of the vegetative nervous system, which disturbance may be referred back to a wide variety of causes, both psychic and physical. In the continuous form of this disease, there is an abundant flow of gastric juice, usually of watery appearance but occasionally light green, in which free hydrochloric acid is always present, usually in increased amounts. Repeated examination of the fasting stomach reveals the presence of large quantities of gastric juice. The excessive secretion which occurs only in response to the taking of food (the digestive form) is merely an evidence of great irritability of the secretory apparatus. Disturbed motility, most often due to ulcer, is a frequent cause. In intermittent hypersecretion, the excessive flow of gastric juice occurs only at irregular intervals, most frequently in paroxysms. Many clinicians believe that this type of hypersecretion is of purely reflex nervous origin, and are inclined to attribute it to tabes dorsalis, brain tumor, multiple sclerosis or other disease of the central nervous system. It has been attributed also to gastric ulcer, gallbladder disease and appendicitis.

Dietary treatment should not be attempted until the cause of these various manifestations of irritative gastric hypersecretion are, if possible, ascertained and corrected. Errors in diet, constipation, appendicitis or cholecystitis, if present, should receive attention. In every instance the possibility of ulcer should first be considered, and in many cases, even though a positive diagnosis can not be made, the patient should receive the diet appropriate for ulcer. The diet should be bland and nonirritating and should consist largely of milk, eggs and cereals; such a diet as has been recommended above for hyperchlorhydria. Gastric lavage accompanied by the administration of atropin will frequently give a large measure of relief.

DEPRESSED GASTRIC SECRETION

Achylia Gastrica.—Achylia gastrica is probably accompanied always by atrophy of the gastric mucosa, as the result of which there is a cessation of gastric secretion. It is often assumed that in this disease there is absence of pepsin as well as hydrochloric acid, but it is now known that variations of the two do not necessarily run parallel. Pepsin is often present in the absence of acid; in fact, there is some doubt as to whether pepsin is ever entirely absent. Therefore it suffices in the study of this disease to direct attention solely to the acid content of the gastric juice.

No sharp dividing line can be drawn between mere hypochlorhydria on the one hand and achylia on the other; they probably represent different degrees in the same functional disturbance. Hypochlorhydria may occur as a mere depression of secretory activity without recognizable organic change, or it may be the expression of beginning atrophy, which is to lead later to achylia.

Achylia gastrica simplex has been regarded by some as a distinct disease entity. Martius,[16] in arguing for its separate identity, emphasizes the following salient characteristics; the fasting stomach is empty; the gastric fluid has a neutral or faintly acid reaction; there is absence of ferment action even though hydrochloric acid is added to the gastric contents; these contents show considerable mucus, and the gastric mucosa is extremely vulnerable to injury. Attempts have been made to identify it as a distinct disease also on the basis of histologic changes in the mucosa. The greater probability, however, is that achylia gastrica simplex represents merely the end stage of a chronic gastritis which may or may not previously have been evident, and that the histologic changes seen in the wall of the stomach are merely those of chronic gastritis. The absence of hydrochloric acid and perhaps occasionally of pepsin can be regarded merely as the result of glandular atrophy.

The existence of a purely nervous achylia is questionable. I am inclined more to the belief that the so-called neurasthenia which is sometimes an accompaniment of this condition is in itself due to the gastritis or other disease which leads to the achylia.

Atrophy of the gastric mucosa with its resulting achylia can be the accompaniment of a number of diseases, among which are carcinoma of the stomach, pulmonary tuberculosis, pernicious anemia, diabetes, syphilis, nephritis and cholelithiasis. It is practically always an accompaniment of pernicious anemia. Whether the anemia or the achylia occurs first, and the possible rôle achylia may play in the production of the anemia, are difficult questions. We can say only that the blood changes are by no means the sole features of pernicious anemia, and that it is easily possible that the underlying cause of the anemia is also responsible for the achylia. The relation of achylia to this and other diseases is discussed in order to explain the necessity for recognizing if possible the entire clinical picture before attempting dietary regulation.

The diet should be that which is best suited to the basic disease. If the patient has pernicious anemia, the diet of Minot and Murphy, which contains an abundance of liver (page 535), should be prescribed; if he has chronic gastritis, the diet advised for this disease is appropriate. It is essential always that the patient have sufficient food; the tendency is too great in this disease to curtail the diet rigidly both as to quantity and as to variety.

Diarrhea is a frequent accompaniment of achylia, and until this is corrected the food should be simple and nonirritating. Milk and cereals should form a large part of the menu. In the Hillman Hospital in Birmingham, there are a great many patients who complain merely of intractable diarrhea, and whose gastric contents show complete anacidity. I am satisfied that most of these have chronic gastritis of long standing, the result perhaps of dietary faults or of the abuse of alcohol. We have learned that to put these patients to bed on an all milk diet and to give them liberal doses of hydrochloric acid, within a few days brings wonderfully satisfactory results. After this they are permitted to leave the hospital with the type of diet advised in the foregoing for chronic gastritis.

For further discussion of achylia gastrica the reader is referred to a recent article by Faber.[17]

MOTOR DISTURBANCES OF THE STOMACH

Motor disturbances of the stomach are of vastly more importance than anomalies of secretion; and yet, because they are always dependent on some other disease, they can receive little discussion here. The dietary treatment is properly that of the underlying cause. The classification used by Boas, which recognizes grades of motor insufficiency without attempting to define the cause, seems best Insufficiency I includes those conditions in which the stomach empties itself slowly but completely; Insufficiency II those in which complete emptying does not take place. Each group embraces a wide variety of diseases.

Gastric atony is the name given to cases of the first group when they are not designated by the disease ultimately responsible for the motor insufficiency. This is a fairly well defined clinical complex, but it is in no sense a disease entity. In its advanced stages it is easily recognized in the fluoroscope by the lack of muscle tone and poor "peristole." The faccid, almost inert stomach with its ineffectual efforts at contraction which when filled loses its shape and widens out at the bottom like a bag, is typical. Often this is merely one phase of a general myasthenia. It may be constitutional, such as is expressed in habitus asthenicus or asthenia universalis, or it may be part of an acquired asthenia the result of debilitating disease. It sometimes comes from abuse of the stomach with food or alcohol; or it may be the result of a wide variety of diseases of either intragastric or extragastric origin, among which may be included chronic gastritis, cholelithiasis, chronic constipation and pulmonary tuberculosis.

The subjective sensations which accompany gastric atony are dependent in large part on the emotional and nervous imbalance which is a part of the general asthenic state, rather than on the motor insufficiency itself. Hence, treatment should be directed to the patient as a whole rather than to his stomach alone; it should not only look to the protection of the stomach, but also to improvement in moralé, stamina and general muscle tone.

Before instituting treatment, effort should be made always to determine the cause of the atony, and then to correct it. At times no satisfactory cause can be found, and the diagnosis will necessarily be constitutional asthenia. Patients of this group demand a general upbuilding treatment with rest and an abundance of nourishing food, such, for instance, as was outlined under the "rest cure" for nervous patients (see page 652).

There are certain general rules which are applicable to the dietary regulation of practically all forms of gastric atony. Milk is the best food; it should be prescribed in large amount, say from 1 to 2 quarts daily, but it should be given at frequent intervals rather than in large quantities at one time. Its nutritive value may be enhanced by the addition of cream, provided the latter does not cause discomfort or diarrhea. Additional fat may be given in the form of butter, but fat in other forms should, as a rule, be avoided, Cereals with cream and eggs cooked in any style may also be taken in abundance. Bread had best be toasted and should be chewed thoroughly; hot breads and pastries should be avoided. Meats may be given, but they should be tender and should preferably be served in finely divided form. Oysters are good.

All bulky foods which are not of great caloric value, such as green vegetables, should be avoided. Stewed fruits in small quantities and fruit juices may be given. Large quantities of fluids should be avoided, and for this reason soups are considered undesirable. The meals should be small and frequent and the food well masticated. The stomach should never be overloaded.

A certain amount of individualization is essential, and it is often necessary to change the dietary regimen to meet the vagaries of the stomach of the patient undergoing treatment. At the same time, emphasis should be laid on the danger of acceding to unreasonable whims and phobias which may have taken possession of the patient.

Constipation is a frequent accompaniment of gastric atony, and yet it is readily seen that the diet just advised is not calculated to further the movement of the bowels. Corrective measures other than diet must be used. One difficulty is that the long continued injudicious use of drastic purgatives is in itself sometimes the cause of the very condition to be corrected. Better hygiene and attention to the general rules recommended for the treatment of constipation will accomplish something (see page 552). Cascara and other laxatives may be used cautiously, but my own decided preference is for plain agar in relatively large amounts, say three teaspoonfuls twice daily after meals. Agar is not a drug; it leaves the stomach quickly and can do no harm. It prevents constipation by so altering the intestinal contents as to favor their easy propulsion through the intestine.

Rest in bed, especially in the more severe cases, is often of advantage. Lavage is also good, particularly in the more advanced grades of atony and when chronic gastritis is present. It is probably unnecessary in the milder cases. Neurasthenic persons with gastric atony had best not be taught the use of the stomach tube, however, as they are prone to use it too constantly.

MENUS FOR PATIENTS WITH GASTRIC ATONY

Use whole milk (2 parts of milk and 1 part of cream)
(Feedings may begin at 8 and end at 10 if desired)

FIRST DAY:
6:00 a. m.: ½ glass orange or other fruit juice
8:00: Well cooked oatmeal with cream and sugar, glass milk, rich
1 shirred egg
10:00: Toast, stewed fruit, a little butter, rich milk
12 Noon: Panned oysters on toast, glass milk
2:00 p. m.: 1 glass milk, cold cereal, cream and sugar
4:00: 2 soft boiled eggs, 1 slice toast with butter, rich milk
6:00: Creamed oysters on toast or poached egg, rich milk
8:00: Stewed apples, 1 slice toast, glass milk

SECOND DAY:
6:00 a. m.: Hot glass milk with toasted crackers
8:00: Well cooked Farina with cream and sugar
Soft boiled egg, 1 slice toast, milk
10:00: Prune pulp with cream, 1 slice toast, glass milk
12 Noon: Very tender broiled steak, toast, milk

2:00 p. m.: Soft cooked egg, toast, milk
4:00: Glass milk, toast
6:00: Creamed or panned oysters on toast, milk
8:00: Milk and egg shake or glass orange juice

Third Day:
6:00 a. m.: Cereal with cream and sugar
8:00: Poached egg on toast, stewed apples, glass milk
10:00: Scraped beef patty, toast, milk
12 Noon: Cream of wheat with butter, toast, glass orange juice
2:00 p. m.: 1 egg omelet, toast, butter, milk
4:00: Creamed oysters on toast, milk
6:00: Soft boiled egg, toast, milk, butter
8:00: Baked apple with cream, toasted crackers, butter, milk

Fourth Day:
6:00 a. m.: 1 glass orange juice
8:00: Oatmeal, cream and sugar
Shirred egg, toast, butter, milk
10:00: Stewed prunes with cream, toast, milk
12 Noon: Serving roast lamb, very tender, no gravy
Rice with butter, toast, milk
2:00 p. m.: Soft boiled egg, toast, milk
4:00: Baked apple with cream, glass milk
6:00: 2 egg omelet or scrambled
Cream of wheat with butter, milk
8:00: Milk and egg shake

Fifth Day:
6:00 a. m.: 1 glass orange juice
8:00: Cereal with cream and sugar
Poached egg on toast, milk
10:00: Milk, toast, apple sauce
12 Noon: Panned oysters on toast
Rice with butter, milk
2:00 p. m.: 1 scrambled egg, toast, milk
4:00: Milk and egg shake
6:00: Cream of wheat with butter, coddled egg
8:00: Prunes with cream
Toast and milk

Gastroptosis or Gastroenteroptosis.—This is not a disease, and per se it is of no clinical significance. The mere fact that the stomach is situated low in the abdomen, or even in the pelvis, is not evidence of disease, for the stomachs of many robust people are so placed. It is true, however, that the same conditions, constitutional or acquired, which produce the muscular weakness of gastric atony will usually lead to relaxation of all abdominal support and thus to gastroptosis. The question of diet and other treatment, then, rests on the tonicity of the gastric musculature and not on the mere position of the stomach. If the muscle tone of the stomach is good, as evidenced by regularly coordinated peristaltic waves, and if it empties itself in a proper length of time, no treatment is required. If, however, this organ when filled with a contrast meal appears as a mere distended bag and without normal peristalsis, then the patient should have the diet just advised for gastric atony.

Motor Insufficiency of the Second Grade.—Such insufficiency is due to stenosis, usually of the pylorus, rarely to an "hour glass" contraction. This may be due in turn to scar formation, to a manifest ulcer, to pylorospasm from an erosion or other reflex cause, to adhesions from a perigastritis or cholecystitis, to carcinoma, to syphilitic infiltration or to linitis plastica with hypertrophic stenosis. The inability of the stomach to empty itself leads to stagnation of its contents and gradually to great dilatation. The resulting gastrectasis may be of such extreme grade that the stomach cavity is three or four times that of the normal stomach. Fermentation of the stagnating contents follows, with abdominal distress, vomiting and emaciation. The roentgenographic picture is typical and unmistakable.

The treatment of pyloric stenosis and gastrectasis is that of the underlying disease; most often it is surgical. When there is recognizable ulcer, a dietary regimen appropriate for this disease should be prescribed. Sippy reported wonderfully satisfactory results from the use of his ulcer cure even after the development of pronounced and long standing pyloric obstruction. When the obstruction is due to causes other than ulcer the diet should in general be that advised for gastric atony. Particular care should be taken to prescribe only the most nourishing foods and those which are nonstimulating and nonirritating. Milk, eggs, cereals with cream, milk toast, mashed potatoes, lean fish and finely chopped tender lean meats are suitable. Emphasis should be laid on the necessity for frequent feedings which are small in quantity.

Constipation may be a distressing factor, and while preparations for the surgical relief of the obstruction are under way, various expedients for moving the bowels may be tried; if the pylorus is patent, simple laxatives, mineral oils or agar may be given, or enemas may be used.

Lavage accomplishes wonders for the patient's comfort and sense of well-being. Nausea, heart burn, thirst and other forms of distress are relieved, and the appetite is improved. The stomach should be washed out daily, either before breakfast or at bedtime. It is sometimes of advantage to add boric acid to the water in the proportion of a teaspoonful to the liter. Both lavage and dietary regulation, however, are in the vast majority of cases mere subordinate measures which are useful in preparing the patient for operation. In a few instances the pyloric obstruction due to an ulcer may be relieved by diet; but as a rule (provided it is not due to syphilis) pyloric obstruction of this grade demands surgical measures.

Acute Dilatation.—Such dilatation of the stomach with its distressingly ominous train of symptoms may appear in the course of an infectious disease, after an abdominal operation or following gross indiscretions in diet. It requires no dietary regulation, for no food should be permitted. Gastric lavage should be given immediately.

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CHAPTER XVIII

DISEASES OF THE DIGESTIVE ORGANS (CONTINUED)

THE GASTRIC NEUROSES

Nervous Dyspepsia.—This is the most frequent form of digestive distress. It is a true neurosis the dominating feature of which is an increased irritability of the gastric sensory nerves, to which are sometimes added, without organic change, motor and secretory disturbances. As a rule, it forms merely one phase of a larger symptom complex, the psychoneurosis, and includes the widest variety of digestive discomforts. Anything which upsets a person's nervous balance—mental strain, overwork, grief, debilitating illness, chronic intoxication—may be an exciting factor, but in my experience nervous indigestion seldom if ever occurs, no matter what the provocation, in a person with a fundamentally stable nervous system. It always indicates emotional imbalance. The person is born with an unstable nervous system which is predestined sooner or later to break, and the nervous strain, illness or other factor which presumably starts the trouble plays merely a subordinate rôle. It is important for both physician and patient to understand this thoroughly, for it is only through such understanding that future trouble in this or some other physiologic area may be avoided.

The recognition of nervous dyspepsia is not always easy; for ulcer, carcinoma, chronic gastritis and other organic diseases of the stomach may for a time simulate it. Extragastric diseases, such as pernicious anemia, chlorosis, nephritis and paresis, may also be accompanied by symptoms of similar nature referable to the stomach. As a rule, however, patients with nervous dyspepsia present other recognizable stigmas which indicate that the gastric distress is of psychic origin, and careful observation will almost always reveal evidences of emotional imbalance. Then, too, the variability of the symptoms, their independence of the digestive processes, their bizarre nature, and the fact that they are often absent when the patient is dining out or is otherwise entertained, are all suggestive.

Gastric neuroses may be polysymptomatic or monosymptomatic. Among the latter may be included an abnormally increased appetite (bulimia), anorexia nervosa, nausea nervosa, regurgitation, rumination, aërophagia with loud explosive-like eructations, peristaltic unrest and various other forms of epigastric pain or distress. These symptoms may be alone or in any combination. The same treatment, which is largely psychic and only to a small extent nutritional, with appropriate modifications, applies to all.*

A patient should not be treated for nervous dyspepsia until he has been thoroughly examined. There are two good reasons for this: first, such an examination is necessary for proper diagnosis; second, without it the physician cannot make himself sufficiently secure in the patient's confidence to carry out the necessary psychotherapy. To tell a nervous patient offhand that his troubles are imaginary and that he must forget them, accomplishes nothing. The first step is to convince him by a searching inquiry into his troubles that the physician is genuinely interested, and that he knows what he is about. The successful treatment of nervous dyspepsia presupposes a thorough understanding of the patient, including both his emotional background and his physical makeup.

If there are underlying diseases, the patient must be treated for them, and an effort should be made to correct faulty habits and to remove physical handicaps. The patient may need treatment for grave secondary anemia, chlorosis or syphilis. Rapid eating with poor mastication, irregularity of meals, a poorly balanced diet of ill prepared food, the abuse of the use of alcohol or tobacco and insufficient sleep are errors which sometimes demand attention. Bad teeth and diseased tonsils are handicaps, and may require removal.

The true nature of his troubles and the fallacy of rigid dietary restriction must be explained patiently to the patient, and his many dietary phobias must be combated. He must be induced to eat articles which he erroneously believes to be harmful, and in this way learn that his stomach is able, if given a chance, to perform its work properly. This is the most important part of the treatment; it requires understanding, tact, patience and firmness. To carry it out successfully, it is often advisable to have the patient for a time in a hospital or nursing home.

A restricted diet in nervous dyspepsia is a mistake. It is often a good maneuver to keep the patient during his first two days of hospital treatment on an all milk regimen and then suddenly, when he is a little hungry, to give him a large well balanced meal and insist that he take it. This preparatory semistarvation often places the patient in the proper frame of mind for what is to come. In other cases, the full diet may be begun immediately.

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* Anorexia nervosa was discussed with nervous diseases.

Two rules for the guidance of the physician are pertinent: (*a*) The directions must be explicit, especially in the beginning, not general or vague; (*b*) the treatment must be individual. The patient should be told that he is being given a general well balanced diet such as any normal man should eat, but its arrangement should not be left to his choosing; he is too apt to vacillate and to doubt. He should be told just what to eat; so much milk, so much meat, so much bread and butter, so much fruit and green vegetables, and other foods each day. The food should be prescribed with due consideration for what the market affords and with a little consideration (but not too much) for the patient's preference. At first, a few daily menus may be given in detail.

Each patient with nervous indigestion presents a separate problem. Therefore the directions should be individual, and, above all, the patient should understand that they are individual. To this end his instructions, while preferably written or typewritten, should never be in the form of a printed slip.

Since so many of these patients are constipated, it is always necessary in arranging the diet to provide articles, such as fruits and green vegetables, which will be conducive to a daily bowel movement. Other directions regarding the hygiene of the bowel (see page 552) should also be given.

Physical exercises carried out regularly and according to prescription and hydrotherapy (a cold morning plunge) are helpful adjuvants. Medicines, as a rule, should be avoided, but occasionally in the beginning of treatment a little sodium bromide, say 10 grains three times daily, will so lessen nervous irritability as to enable the patient to regain confidence in his stomach.

The following specimen menus suitable for nervous indigestion provide merely a well balanced diet such as any normal person may take.

MENUS FOR PERSONS WITH NERVOUS INDIGESTION

Simple, well balanced menus. If the patient is inclined to obesity, omit cereals and most sweets.

I.

BREAKFAST:
- ½ orange or small saucer of cooked fruit
- Cereal, cream and sugar
- 1 egg, 1 muffin or toast with butter
- Tea or coffee

DINNER:
- Medium serving beef roast
- 1 medium sized baked potato
- Medium helping of greens; 1 corn muffin or 1 slice of bread with butter
- Salad—tomato or lettuce with French dressing
- 2 tbsp. rice pudding
- Sweet milk or buttermilk

SUPPER:
- 1 egg omelet with broiled tomato
- 2 tbsp. hominy grits with butter
- 2 slices of whole wheat bread or toasted muffins
- Fruit salad with cream dressing
- Glass of milk

II.

BREAKFAST:
- Fruit
- Small serving cornflakes with milk
- Soft boiled egg with 2 strips of bacon
- 2 m. s. slices toast with butter
- Tea or coffee

DINNER:
- Beef stew with vegetable
- 2 corn muffins with butter
- Fruit salad with French dressing
- Small saucer ice-cream
- Milk, if desired, or tea

SUPPER:
- Creamed dried beef on toast
- 1 small baked potato
- Spinach salad with one-half hard boiled egg and mayonnaise
- Saucer peaches or pears (canned)
- 2 slices whole wheat bread and butter
- Glass of milk

III.

BREAKFAST:
- Fruit
- French toast with honey or preserves
- Bacon
- Tea or coffee

DINNER:
- M. h. fish or lamb
- 2. h. tbsp. mashed potatoes
- String beans; corn bread or 2 slices of bread
- Tomato salad with mayonnaise
- Baked egg custard
- Tea or water

SUPPER:
- Scalloped egg en casserole
- Buttered asparagus on toast
- Pineapple and cheese salad with mayonnaise
- 1 toasted muffin
- Jello with 1 tbsp. whipped cream
- Milk

IV.

BREAKFAST:

Orange juice
Oatmeal with cream and sugar
Creamed toast with cocoa
Tea or coffee with cream and sugar

DINNER:

M. h. roast or broiled chicken
Rice with gravy
Baked egg plant; sweet potatoes with 1 marshmallow
Celery and olives
Pineapple sherbet with 2 lady fingers
Tea or milk

SUPPER:

Creamed tomato soup with croutons
Coddled egg en casserole
Stewed corn
Fruit salad with cream dressing
2 slices of whole wheat bread or 3 beaten biscuits
Milk

V.

BREAKFAST:

Fruit; 1 spoon grapenuts with cream and sugar
Scrambled egg with bacon
2 hot biscuits and butter; 1 tsp. jelly
Tea or coffee

DINNER:

A. h. meat or fish
Baked macaroni and tomatoes
Beans or greens
Celery and apple salad
Tapioca pudding
Bread or corn muffins
Tea or milk

SUPPER:

Scalloped or panned oysters
Cream of wheat with butter
1 h. tbsp. peas; 1 slice whole wheat bread
Small lettuce salad with Thousand Island dressing
1 baked banana
Milk

VI.

BREAKFAST:

Fresh or stewed fruit
Minced chicken on toast; grits with butter
2 small biscuits with butter and jam
Tea or coffee

Dinner:

A. h. roast beef or 2 lamb chops
1 h. tbsp. creamed potatoes or sweet potatoes
2 h. tbsp. peas
Spinach salad with egg and mayonnaise
Bread or rice pudding with sauce
2 rolls or corn muffins
Milk or tea

Supper:

Egg omelet with bacon
Small baked potato
Very ripe banana nut salad with mayonnaise
2 average slices of toast with butter
Milk

VII.

Breakfast:

Fruit; cold cereal with milk
Poached egg on toast
1 whole wheat muffin with butter and preserves
Tea or coffee

Dinner:

Broiled or Swiss steak
Sweet potatoes with or without marshmallow
Squash or carrots
Stuffed tomato or lettuce salad with mayonnaise
Apple tapioca pudding
Bread and butter
Tea or milk

Supper:

Cream of oyster soup with crackers
Baked or creamed potato
2 h. tbsp. hot spinach with egg
Saucer canned apricots
Beaten biscuit or bread
Milk

Calories, 3,000 or 3,500 each day

THE DIARRHEAS

To determine the cause of diarrhea a knowledge of the character of the feces is usually necessary. For this purpose the test diet and the methods of examination proposed by Schmidt are generally used.[1] This diet is given the patient for about three days, occasionally longer, or until it is certain that its end-products are appearing in the feces. It provides 110 Gm. of protein, 105 Gm. of fat and 200 Gm. of carbohydrate, giving about 2,247 calories, sufficient for a patient who is not attempting much work.

SCHMIDT'S TEST DIET

Breakfast: 1 pint of milk (or when milk is not well borne, 1 liter of cocoa made from 20 Gm. of cocoa powder, 10 Gm. of sugar, 400 Gm. of water and 100 Gm. of milk), 50 Gm. of zwieback.

About 10 a. m.: 1 pint of oatmeal gruel, made of 40 Gm. of rolled oats, 10 Gm. of butter, 200 Gm. of milk, 300 Gm. of water and 1 egg with a little salt.

Lunch: 125 Gm. of chopped or scraped beef (weighed raw), broiled with 20 Gm. of butter; 250 Gm. of mashed potatoes.

About 4 p. m.: The same as breakfast.

Supper: (About 7 p. m.): The same as 10 a. m.

(Occasionally a little thinly sliced raw ham is added)

Schmidt gives directions in elaborate detail for the study of the feces; for full information, the reader is referred to his monograph. As a rule for ordinary clinical purposes a fairly simple examination is sufficient to give the physician an insight into the nature of the intestinal disturbance. He should take into consideration the odor and the general appearance of the feces. The exceedingly foul-smelling stool, alkaline in reaction and dark brown, indicates proteolytic decomposition, while a light yellow specimen which is acid in reaction and shows bubbles of gas indicates abnormal fermentative activity. A portion of the feces should be spread on a plate for careful inspection; after being thoroughly rubbed up with water, it is examined for connective tissue fragments and pieces of muscle. Sago-like granules of potato indicate poor digestion of starch. Connective tissue particles indicate a disturbance of gastric digestion, and the presence of muscle fibers with recognizable cross striping suggest a failure of the pancreatic ferments. The presence of mucus in a recognizable amount indicates some inflammatory reaction, usually in the large intestine. Pus and blood tell of more deeply seated inflammatory disturbances. As a rule, little can be told from the number and the character of the micro-organisms present, but Schmidt attaches importance to the presence in the test stool of bacteria whose granulose containing bodies stain blue with iodine; this is regarded as an indication of poor carbohydrate utilization.

Intestinal Dyspepsia.—A clear distinction should be drawn between digestive disturbances of the intestine on the one hand and inflammatory reactions on the other. It is with the former that this discussion is chiefly concerned. It includes various digestive disorders, such as accompany failure of the digestive juices, motor abnormalities, disturbances of innervation and invasion of the intestinal tract by foreign bacteria. Associated with these processes there may be in greater or less degree a true enteritis or colitis. Taken as a whole, chronic intestinal dyspepsia, despite the manifold nature of its etiology, represents a fairly well defined clinical complex.

In the majority of instances, the cause of the trouble is a change in the intestinal flora in which foreign disease-producing organisms predominate. This infection is frequently made possible by some prior disturbance of function, secretory or motor, typical of which is achylia gastrica. In such instances the food as it passes into the duodenum is poorly chymified and of such abnormal consistency as to throw an unaccustomed burden on the intestinal tract. It is this, rather than the absence of supposedly bacteriolytic properties of the gastric hydrochloric acid, which permits foreign bacteria to gain foothold and eventually to predominate. This is borne out by the fact that diarrhea frequently accompanies rapid emptying of the stomach, even though hydrochloric acid be present in abundance. At any rate, most of the intestinal disorders of this group follow disturbances of gastric function, either secretory or motor.

Before instituting dietary regulation in intestinal dyspepsia, it is essential to determine the nature of the underlying functional disturbance. The general symptoms, such as lack of appetite, nausea, epigastric pressure, eructation of food and frequent bowel movement are as a rule the same, no matter what the underlying cause, and therefore for a more intimate understanding of the disturbance a certain amount of laboratory investigation is necessary. While examination of the blood may give information of value, particularly when pernicious anemia is present, the most important information comes from the study of the feces. It is well to remember, however, that fermentative dyspepsia with its feces of light color, acid reaction and gas bubbles, and putrefactive indigestion with its dark brown feces, alkaline reaction and characteristic odor, cannot always be clearly differentiated. The two processes may occur simultaneously or one may alternate with the other. Microscopic examination is as a rule advisable, but not infrequently macroscopic examination of feces which have been thoroughly rubbed up with water on a black plate, as Schmidt advises, will reveal the sago-like particles of starch, connective tissue strands, muscle fibers and other things which show wherein digestion has failed. To know the reaction of the gastric contents and the rapidity with which the stomach empties itself, is also of value. It is not always easy to differentiate intestinal dyspepsia from enterocolitis on the one hand and nervous diarrhea on the other. The absence of mucus in the stools speaks against the former, and the finding of undigested food particles in any appreciable amounts speaks against the latter.

Dietary regulation will accomplish much, but emphasis should be laid on the fact that no single dietary regimen is suitable in every case, and indeed that the same diet is not necessarily suitable at all times for the same patient. Since poor chymification of the food is probably an important factor, no article should be given which cannot be thoroughly and easily chymified. This means that in all cases salads and other leafy vegetables should be avoided, and that only those vegetables should be given which can be thoroughly cooked and prepared in puree form. For the same reason, care should be taken not to overload the stomach; the meals should not be large.

If the feces show the presence of undigested starch, more albumen and less starchy food should be given. Eggs, meat soups, vegetable purees and milk with a little toast or zwieback should be the chief articles of diet. To this may be added vegetable purees. A limited amount of carbohydrate in the form of sweets such as honey and preserved fruits is often well borne.

If, on the other hand, putrefactive processes predominate or the feces show the presence of muscle fibers or of connective tissue in considerable amount, meats should as far as possible be removed from the diet. The food in such cases should consist largely of the simpler carbohydrates with very little protein; that is, gruels with cream, zwieback, toast, rice, mashed potatoes, bread and butter with orange marmalade and other preserves and milk.

Many clinicians object to the use of milk in intestinal disturbances. This no doubt holds good for children, but in my experience with adults milk is as a rule well borne in both forms of indigestion—fermentative and putrefactive. It is best given with other foods, say one or two glasses at a meal. Acidophilus milk sometimes corrects the trouble by changing the intestinal flora. It should be given in amounts of 1 or 2 quarts daily, with the addition perhaps of milk sugar.

Fats as a rule are not well borne and therefore should be limited in amount. They should be taken chiefly in the form of butter, cream and egg yolk. No definite rules, however, can be laid down, and the physician must be guided in the fat allowance by the experience of the individual patient.

It is not advisable to permit the patient to continue indefinitely on any one type of food. There should be frequent examinations of the stool, and changes in the dietary prescription should be made accordingly. It is said that there is scarcely any other illness which demands of the physician greater dietary finesse than intestinal dyspepsia.

MENUS FOR PATIENTS WITH INTESTINAL INDIGESTION

I.

8:00 a. m.: Poached egg on toast, cocoa
10:00: Milk, toast, preserves
12:30: Strained vegetable soup made with beef broth
Coddled egg, toast, marmalade
3:00 p. m. Egg and milk shake
6:00: Puree of split pea soup with croutons
Soft boiled egg, toast
8:30: Glass milk with zwieback

II.

8:00 a. m.: Milk toast, cocoa or milk
10:00: Milk and egg shake
12:30: Puree of spinach with zwieback
1 egg omelet, toast, honey, milk
3:00 p. m.: Glass milk
6:00: Beef broth with zwieback
Scrambled egg with toast, tsp. marmalade or preserves
8:30: Egg and milk shake

III.

8:00 a. m.: Egg omelet, 1 slice toast, preserves
Cocoa or milk
10:00: Glass milk, 2 zwieback
12:30: Puree of bean soup with 1 zwieback
Shirred egg, 1 slice toast, milk
3:00: Milk and egg shake
6:00: Beef broth, egg on toast, milk
8:30: Milk with zwieback

MENUS FOR PATIENTS WITH INTESTINAL INDIGESTION (PUTREFACTIVE)

I.

8:00 a. m.: Oatmeal gruel with cream
Toast with butter and marmalade, cocoa
10:00: Glass milk Acidophilous with milk sugar, 1 zwieback
12:30 p. m.: Mashed potato with hard boiled egg yolk
Toast, butter, preserves, milk
3:00: Cornmeal gruel with cream
2 zwieback, glass milk or Acidophilus with milk sugar
6:00: Well cooked rice with milk and butter
Toast, butter, marmalade or honey, milk
8:30: Barley gruel with butter or cream, milk

II.

8:00 a. m.: Cream toast with egg yolk, cup cocoa or milk
10:00: Oatmeal gruel with cream, milk
12:30 p. m.: Mashed potatoes with butter, toast, milk
3:00: Rice with butter, milk
6:00: Cornmeal gruel with cream
1 slice toast, honey, milk
8:30: Glass milk, zwieback, butter

III.
8:00 a. m.: Barley gruel with cream
Toast, preserves, milk
10:00: Milk toast
12:30 p. m.: Mashed potato with egg yolk
Toast, honey, milk
3:00: Cornmeal gruel with cream, zwieback, butter
6:00: Rice with milk and butter
Toast, preserves, cocoa
8:30: Oatmeal gruel with cream
Toast, milk

Fermentative dyspepsia is regarded by some clinicians as a distinct disease entity. Schmidt and Strassburger[2] believe that it is dependent on a constitutional defect in the digestive juices with faulty diastatic action which leads to poor utilization of starch and permits subsequent fermentation. The chief seat of the disturbance is believed to be the ileum. Whether this condition is entitled to separate consideration is hard to say. Occasionally patients are seen whose inability to digest potatoes, fruits, and other starchy articles is a dominating feature of their disturbance. These people are prone to diarrhea, but usually they have formed or partially formed bowel movements which show the fermentative characteristics of a bright yellow color, acid reaction and "bubbly" consistency. They complain of frequent abdominal distress and of the passage of large quantities of gas by bowel. On both macroscopic and microscopic examination after the test diet, the feces show clumps of undigested potato granules and other evidences of poor starch utilization. Occasionally a little mucus appears as evidence of a mild inflammatory reaction.

The diet should contain only minimal quantities of carbohydrate, and this should be in the form of gruels with milk and other easily digested foods. Salads, fruits and the leafy portions of vegetables particularly should be avoided. Eggs, fish, oysters and tender meats should be eaten in relatively liberal amounts. Milk and milk preparations are usually well borne; fats, poorly. Gelatin, slightly sweetened, may be eaten. Gradually as the stools become darker and take on an alkaline reaction, and as undigested starch disappears, toast and gruels may be permitted in larger amounts, and other carbohydrate foods may be added.

MENUS FOR PATIENTS WITH FERMENTATIVE DYSPEPSIA

(Use small amount sugar in desserts)

I.
8:00 a. m.: Panned oysters (6 or 8)
1 zwieback
Cocoa or milk

10:00: Small serving oatmeal gruel with milk
12:30 p. m.: Large serving broiled tender steak, 1 slice toast
Lemon or orange Jello, milk
3:00: Soft boiled egg, 1 zwieback
6:00: Average helping broiled fish with hard boiled egg
1 slice toast, milk?
8:00–8:30: Boiled egg custard
Milk

II.

8:00 a. m.: Broiled steak, 1 slice toast, cocoa or milk
10:00: Soft boiled egg
Cornmeal gruel with milk
12:30 p. m. Boiled fish with egg sauce, 2 zwiebacks, Spanish cream
3:00: Oatmeal gruel with milk, 1 coddled egg
6:00: 6 or 8 large panned oysters on toast
Orange or cherry Jello, milk
8:00–8:30: Glass milk

III.

8:00 a. m.: 2 soft boiled eggs, 1 slice toast
Cocoa or milk
10:00: Spanish cream, glass milk
12:30 p. m.: Very tender steak or roast
Toast, milk
3:00: Shirred egg, toast, milk
6:00: Broiled fish or panned oysters, 1 slice toast
Milk, lemon Jello
8:30: Oatmeal gruel with milk, glass milk

Nervous Diarrhea.—It is difficult to say whether this type of diarrhea is dependent solely on an abnormal motility of the bowel of nervous origin, or whether there are in addition other more fundamental factors, such as a change in the nature of the digestive ferments. While the diarrhea is clearly dependent on nervous influences, it is conceivable that these influences may act by changing the secretions in such a manner as to alter profoundly the nature of the intestinal contents and thus to necessitate in turn a rapid emptying of the bowel. Part or all of this may be due to mere circulatory disturbances, to what may be termed perhaps a "blushing of the gut." The stools are not only watery, but at times they show evidences of failure of digestion, and occasionally there is a little mucus.

The treatment is that of the underlying nervous instability. Rigid dietary regulation is unnecessary, perhaps even harmful. It is essential merely that the patient secure enough food of the right kind. Bromides are frequently of value. Many of these patients suffer from physical as well as nervous exhaustion. When they are permitted rest and tranquility, the intestinal disturbances cease. In the more severe cases, the "rest cure" (see page 649) should be used.

Acute Enteritis.—This disease, which represents an actual inflammation of the bowel, may be due to the widest variety of causes. It is not always distinguishable from the intestinal dyspepsias above described, since the latter are frequently accompanied by mild degrees of enteritis and may show small amounts of mucus in the feces. The presence of mucus in appreciable amounts, however, can as a rule be taken to indicate outspoken enteritis.

Anything which irritates the intestinal mucosa, whether mechanical or chemical, can produce enteritis. In the vast majority of instances, however, the disease is due to bacterial invasion. It may be merely a part of some well characterized infectious disease, such as typhoid fever, cholera, amebic or bacillary dysentery, or tuberculosis; it may be due to some recognizable infection without a well defined clinical complex, such as the paratyphoid infection which gives rise to epidemics of food poisoning; or, while apparently of infectious origin, it may be due to some unidentified organism. And, finally, the diarrhea may be due to toxins which have developed in infected foods (*Bacillus botulinus*) rather than to actual infection of the patient himself.

In most instances there is inflammation of the entire alimentary tract, so that the disease may be regarded as a true gastro-entero-colitis. The nausea and vomiting which usually occur first probably represent an acute gastritis. The great prostration, thirst, fever and pains in the muscles are probably dependent on loss of water rather than on so-called toxemia.

Recognition of acute enteritis must depend on the symptoms. The watery stools will in the beginning contain undigested food particles, but later there is in the feces little more than bacteria, water and mucus. There are myriads of micro-organisms in the stools, and except in a few diseases, such as amebic dysentery, little can be learned from their study. Occasionally, as in epidemics due to the paratyphoid or the dysentery bacillus, agglutination tests will tell the story.

Treatment should as a rule be begun by the administration of a laxative, such as one or two tablespoonfuls of castor oil, but if there has been profuse diarrhea and the intestine is already cleared of offending material, this is unnecessary. No food should be given for the first twenty-four or perhaps forty-eight hours. Then simple gruels, such as was advised in acute gastritis, should be prescribed. Milk is usually well borne, and in many instances it should for a time be the only food. Strained oatmeal, farina, cream of wheat, milk toast and bouillon, to which a little toast has been added, may also be given at this time. Later an occasional egg, and then a little tender meat with toast, butter and preserves, may be added.

It is essential in acute enteritis that the patient be kept absolutely at rest in bed. Not infrequently opium in the form of tincture of opium or as Dover's powder should be given. Warm applications to the abdomen add to the patient's comfort.

MENUS FOR PATIENTS WITH ACUTE ENTERITIS

Second and Third Days:
Milk every 2 hours

Fourth, Fifth and Sixth Days:
7:00 a. m.: Strained oatmeal gruel with milk
9:00: Milk toast
11:00: Cream of wheat with milk
1:00 p. m.: Bouillon with croutons (1 slice dry toast)
3:00: Farina, glass milk
5:00: Cream of wheat, glass milk
7:00: Strained oatmeal with glass milk
9:00: Milk

Seventh to Ninth Days Incl.:
7:00 a. m.: Strained oatmeal with a little butter
Glass milk
9:00: Milk toast, with soft boiled egg
11:00: Farina with butter, ½ slice toast
1:00 p. m.: Glass milk, 1 slice toast, butter, 1 tsp. preserves
3:00: Small piece very tender broiled steak, ½ slice toast
Milk
5:00: Cream of Wheat with butter, glass milk
7:00: Glass milk, toast, butter, marmalade
9:00: Strained oatmeal with butter, glass milk

Tenth to Twelfth Days Incl.:
(Routine may be changed from day to day to prevent monotony.)
(Feedings may be from 6–8 if desired.)
7:00 a. m.: Oatmeal gruel with butter, glass milk
9:00: 1 soft boiled egg, ½ slice toast, cocoa?
11:00: Cream of wheat with a little butter, glass milk
1:00 p. m.: 1 pat of scraped beef, 1 slice toast, 1 tsp. marmalade
3:00: 1 glass milk
5:00: 1 poached egg on toast, glass milk
7:00: 1 spoon creamed fish flakes, 1 zwieback
9:00: Glass milk, 1 slice toast, 1 tsp. preserves

Chronic Enterocolitis.—This may represent merely a continuation of an improperly treated acute enteritis or it may be chronic from the beginning. It usually expresses itself by marked irregularity of the bowel; there is alternating constipation and diarrhea, seldom for any long period normal bowel movements. Occasionally there is a tendency to thin frequent bowel movements with an abundance of mucus.

Pain and discomfort in the abdomen are variable symptoms. Examination of the feces may show either putrefactive or fermentative changes, or both. There is usually considerable mucus as well as an abundance of undigested food particles.

Treatment depends in part on the nature of the digestive disturbance. If the examination of the stool reveals evidences of fermentation and there is an abundance of undigested potato or starch granules, with bacteria which stain blue with iodine, it is best to prescribe for a time a diet which consists largely of albumen. If, on the other hand, putrefactive changes predominate and there are evidences of poor digestion of meat, a diet rich in carbohydrate with only limited quantities of protein should be given. When both types of digestive disturbance are present, the ingenuity of the physician is taxed to provide a simple, nonirritating diet which will lessen the intestinal irritation. Milk and thin gruels are usually suitable. The food should always be well prepared and should never contain coarse, indigestible articles. Coarse vegetables and raw fruits should be avoided. Carbohydrates should be given largely in the form of toast, zwieback, milk toast and gruels, such as farina or cream of wheat. The meat should be tender and should be served preferably in some finely divided form. Eggs and fish are usually suitable. *Bacillus acidophilus* milk is often of help in changing the intestinal flora.

Mucous Colitis.—This condition is regarded by many as a distinct disease entity. There is usually a history of long standing constipation with the use of drastic purgatives. It is characterized particularly by the passage at times of large quantities of mucus which sometimes takes on a firm consistency and so closely assumes the shape of the intestine as to suggest the passage of a part of the intestinal wall. The attacks of abdominal pain which frequently precede the evacuation of mucus are probably due to efforts at its dislodgment. This disease is usually seen in very nervous patients, and by some clinicians it has been considered a pure neurosis. Von Noorden believed it to be due to constipation and purgation for many years with resulting injury to the mucosa.

There are two opposed views as to the dietary treatment of this disease. Von Noorden[3] insisted on an abundant diet containing large quantities of green vegetables, bran, fruit and other roughage, such as is best suited to the relief of constipation. Schmidt, Boas and others have advised the reverse of this—a bland, nonirritating, nonstimulating diet, which contains milk, cereals, eggs, purees and similar foods.

This difference of opinion may be due not merely to different conceptions of the nature of the disease, but also to the fact that several different pathologic processes perhaps are grouped together as mucous colitis. In my own experience, a patient with the clinical syndrome described by von Noorden as mucous colitis is best treated by the constipation-correcting diet which he advises. On the other hand, a colitis in which the salient feature is active inflammation of the mucosa perhaps leading to ulcer formation is naturally made worse by such a diet, and the patient should be given the bland, nonirritating foods advised by Schmidt. Specimen menus of the type recommended by von Noorden will be found in the section on constipation (page 554); those of the type recommended by Schmidt, in the section on chronic gastritis (page 497).

Sprue.—Sprue is classed among the tropical dysenteries, and is thought to affect only those who have lived for many years in the tropics. Residence in the tropics, however, is by no means essential, as is evidenced by the fact, that in the United States it is not an infrequent disease among residents of the South. Although the clinical complex presented by sprue is well defined and characteristic, there is still some question as to whether it should be regarded as a distinct disease entity. It has frequently been confused with pellagra. E. J. Wood has offered the suggestion that it is identical with pernicious anemia; certainly sprue and pernicious anemia have many characteristics in common. Manson believed that debilitating and enfeebling influences predispose to this disease. Ashford has endeavored to prove that infection with *Monilia psylosis* is responsible, and this theory has many adherents; this author has concluded, however, that *Monilia* becomes pathogenic only when there has been a preceding digestive deficiency. T. R. Brown contributed to the pancreatic deficiency theory in his finding that pancreatic ferments were absent or nearly so from the duodenal contents and the stools; perhaps this is the disturbance which permits *Monila* to gain foothold.

Of the symptoms of sprue, diarrhea is the most constant and the most distressing; it may be merely a morning diarrhea. The very loose stools are of pultaceous consistence, fermented, pale and usually copious. The mouth is sore; the tongue is bright red, sometimes swollen and occasionally covered with superficial erosions. This soreness of the mouth may interfere materially with nutrition. Abdominal distention, particularly after eating, may be a distressing ymptom. Later there is profound anemia indistinguishable fomrs primary anemia.

Many diets have been heralded as specific for sprue. Manson[4] emphasized the fact that success in the treatment of this disease depends on thoroughness. He insisted on absolute rest in bed and a diet consisting only of milk, the patient drinking at most 3 pints during twenty-four hours. He advised that the milk be given in divided doses every two hours, that it be sipped with a spoon, and that the mouth be washed with some mild antiseptic after each feeding. The amount of milk, according to this author, should not be increased until the patient's appetite improves and the abdominal distention disappears. It may then be gradually increased until 6 pints are taken during twenty-four hours. He permitted no additional food until the patient had been free from diarrhea for at least six weeks.

In discussing his milk diet, Manson adds the following comment:

> The only exception to this rule of an exclusively milk diet is fruit, and of all fruits the strawberry appears to be the best. Indeed, strawberries and probably other pulpy fruits appear to have a curative effect on this disease, and may be tried early in the treatment. I have seen strawberries succeed where milk alone has failed.

I should like to add my testimony to the value of the strawberry diet. I have recently seen graphic improvement in two patients with sprue who were changed from the milk to the strawberry diet. Two quarts of strawberries daily, to which is added a little sugar but no cream, is the usual allotment. I have permitted in addition, scraped beef on dry toast, which they were instructed to chew thoroughly. Just what it is in the strawberry which benefits the patient no one can say. They must be fresh; preserved or canned strawberries will not suffice. Wood tells of one patient with sprue who with the changing seasons followed the strawberry crop over the United States.

Thoroughly ripe bananas taken in large quantities, as many as twelve or eighteen daily, have also been used with benefit.

A diet of scraped beef is said sometimes to work well. As a rule, the beef scrapings are made into meat balls and are broiled with just as little butter as possible. At other times, the scrapings from rare beef steaks are eaten direct with the addition of a little toast.

R. H. Turner[5] of the Department of Tropical Medicine of Tulane University has had unusually satisfactory results with a diet possessing the following characteristics: (1) fat content as low as possible, (2) protein content high, (3) carbohydrate as far as possible in the form of bananas and plantains. His diet for the twenty-four hours is constructed as follows: Protein milk made from milk powder (Klim or Dryco) up to 3 or 4 pints; this may be taken in small quantities at frequent intervals if drinking a large quantity at one time causes discomfort. No sugar may be added to any article of diet; saccharin may be used if necessary in coffee, dessert or oatmeal. Two bananas daily should be taken at first, which during the first two or three weeks may be increased to six. These should be over-ripe with darkened skins but without decay. One small broiled steak which has been trimmed of all fat should be eaten daily, and after the first month two may be taken. One small portion of oatmeal which has been cooked for at least two and one-half hours, without cream or sugar (saccharin if necessary is permitted). Two baked plantains without butter or sugar are also permissible; if these are served with the steak, they will serve as an acceptable substitute for bread. Gelatin, which may contain well ripened bananas but no sugar, may be taken ad libitum. The following articles are prohibited: butter, bread, cream, especially ice-cream, rice, potatoes, gravy, sweet milk, cake and candy.

HABITUAL CONSTIPATION

It is difficult to define constipation, because there is no fixed rule as to the frequency with which the bowels should move. For comfort and health, the majority of people must have a daily bowel movement, but there are others who need an evacuation only every second or third day. Numerous instances have been reported of people who empty the bowels at intervals of several weeks, and occasionally we hear of a person who, while maintaining apparent health and attending to his daily duties, has a bowel movement only every three or four months.

The reason why different people make such widely differing demands on the colon can be explained perhaps when we inquire into the baneful influences of constipation. Unquestionably, infrequent or insufficient bowel movement leads to a certain well recognized train of symptoms: malaise, headache, mental hebetude, poor appetite, coated tongue and foul breath. Still other clearly defined harmful effects were demonstrated by Donaldson[6] on five normal men who voluntarily refrained from bowel movement for a period of about four days. He saw in these subjects, in addition to the symptoms just related, loss of the power of concentration, easy fatigue, delayed reaction time of the special senses, elevated basal metabolism and increased blood sugar. These men experienced a complete return to normal within an hour after securing a bowel movement by enema.

The disagreeable and debilitating influences of constipation are commonly believed to be due to toxins absorbed from the colon, so called auto-intoxication. Space will not permit a thorough discussion of this subject here and those interested are referred to the excellent summary of the literature by Alvarez.[7] This author demonstrates convincingly that intoxication cannot be the sole factor, if indeed it plays any rôle. Every one knows that when, during constipation, evacuation of the bowels has been accomplished, relief is as a rule immediate; and yet it is evident that if absorbed poisons were the cause of the discomfort, this relief could not be experienced so quickly. As Alvarez so aptly expresses it, we can just as well talk of sobering a drunken man by taking the bottle out of his hip pocket. Some other explanation must be sought. The suggestion has been made repeatedly, and this seems most reasonable, that the baneful influences of constipation are due to pressure of the fecal mass in the lower bowel, pressure both on a sensitive mucus membrane and on the pelvic nerves. The author just quoted suggests an additional and perhaps an equally important factor, reverse peristalsis; this carries some of the intestinal contents back into the stomach and may even transport material from the stomach still higher. The discomfort and distress of an overloaded intestine is genuine, but nevertheless in the last analysis it would appear to be of nervous origin.

This explanation would solve the problem of the varying tolerance which different people exhibit toward an overloaded colon, for it recognizes the predominating influence of individual nervous susceptibility. It is only by taking into consideration this factor of individual susceptibility that we can account for the wide differences in the way in which people react to constipation.

The efficient treatment of persons with constipation presupposes an understanding of the manner in which the colon acts. The liquid chyme passes rapidly through the small intestine and is ejected in spurts into the cecum; it is prevented from regurgitating by means of the ileocecal sphincter. The feces accumulate in the cecum and ascending colon, where through the absorption of water they are changed to a soft semiliquid mass. Further absorption of water occurs as the transverse colon is reached, and the feces then take on a firmer semisolid consistency.

The chief function of the colon is to hold the feces until it is convenient to defecate; it serves therefore during the greater part of the time merely as a reservoir. When the time comes for the feces to move forward, this is not accomplished by gradual progression but rather by a few brief forceful movements. During the rest of the day the colon is probably inactive. This mass peristalsis as it is now called was first observed by Holtzknecht,[8] who described it as a powerful peristaltic wave involving the entire large intestine, which is repeated three or four times daily. It was later observed by Case, Hurst and others. Hurst[9] was able to demonstrate in the fluoroscope that the movement follows the taking of food into the stomach, and he regards this as the normal stimulus for the colon reflex. This influence of feeding upon the movements of the large bowel has been observed by others.[10] The fecal mass is thus from time to time carried forward in toto until it reaches the pelvirectal flexure, where, owing to the tonic contraction of the circulatory muscular fibers, further progress is stopped.

Nothing enters the rectum until immediately before defecation. At the usual time for this act, as a rule just after breakfast, there is a relaxation of the muscle fibers at the flexure, and active peristalsis of the colon carries forward a portion of the feces into the rectum. The circumstances which give rise to this movement are numerous and complex; the active movements of the early morning, the usual glass of cold water, the cold bath perhaps, and above all the taking of food, are the factors which in the normal person initiate this train of events. The presence of feces in the rectum then gives rise to a sensation of fulness—a muscle sense rather than a tactile sense—which in turn produces the desire to defecate. As the person goes to stool, defecation is initiated by certain voluntary movements of the abdominal muscles, the diaphragm and the levati-ani muscle, which increases abdominal pressure and forces additional feces into the rectum, the distention of which gives rise in turn to reflex impulses from the lumbar cord. This brings about propulsive movements of the colon and simultaneously a relaxation of both anal sphincters, which results in an emptying of the distal part of the large intestine.

Alvarez[7] has called attention to the fact that the entire colon is not completely emptied at defecation; a certain amount of fecal material remains in the ascending and perhaps a part of the transverse colon. This goes forward during the day and is presumably evacuated the following morning. In fact, the studies of this author and Freedlander[11] have revealed the interesting fact that under normal conditions there may be considerable delay in the passage of the feces, and that all portions may not move forward with the same rate of speed. They write:

> In the study here reported, fifty small glass beads were used as an index to the rate of progress of the everyday food of the individual. Ordinarily, some 15 per cent of these beads are passed on the first day; 40 per cent on the second; 15 per cent on the third, and 10 per cent on the fourth day. After that, it may take days or weeks before the last few beads are recovered. The rate of progress varies widely in normal

persons. No symptoms of disease were found in men and women who took a week or more to pass 70 per cent of the beads. Fast rates, i. e., 85 per cent in twenty-four hours, are associated with the passage of soft, badly digested stools.

Whether the behavior of these glass beads is a fair criterion of fecal progress it is difficult to say, but the result of these studies is distinctly illuminating.

Types of Constipation.—Constipation may be manifested in three ways: defecation may occur with insufficient frequency, the stools may be inadequate in amount, or they may be abnormally hard and dry. Two main types have been described—atonic and spastic. The former type of constipation is by far the more common. It is due to an insufficiency in the peristaltic movements, either relative or absolute. This in turn may be due to muscle weakness, to lowered reflex sensibility, or to feces which are of such abnormal consistency that they do not give stimulation or are difficult to propel along the intestine. Hurst has given the name dyschezia to a condition in which the evacuation of the rectum is never complete; it belongs in the atonic group, but according to this author demands special therapeutic consideration. Spastic constipation, which is due to obstruction offered by spasmotic contraction of the intestine, and which is manifested by small hard fecal masses or thin ribbon-like strings, is relatively rare; it is usually seen in neurotic persons.

Errors, which lead to constipation whether hygienic, dietetic or otherwise, should be corrected before other therapeutic measures are attempted. Faulty habit in regard to the time or regularity of going to stool, usually begun in childhood, is one of the most frequent causes; constitutional constipation, so called, is no doubt of this group. Old age and debilitating diseases are accompanied by constipation because of the associated muscle weakness. The bowel irregularity which is a part of chronic colitis probably represents a damage to the plexus of Auerbach which is due to the inflammatory reaction of the mucosa. The extreme degrees of constipation seen in neurasthenic and insane patients, especially in those with melancholia, is probably due to depression of nerve reflexes. On the other hand, extreme nervousness and irritability may be accompanied by spastic constipation and made worse by irritating laxatives; irritation of a susceptible colon in a patient with an excitable nervous system can easily lead to this type of constipation.

A bowel content which is grossly abnormal in consistency and composition is a frequent cause of constipation. To permit of easy propulsion and in order to impart to the mucous membrane just the proper stimulation, the colonic contents must be semisolid, nonirritating, and relatively free from undigested food remnants. This is largely a question of diet, for in order to produce feces of this character the food must be well digested and must contain an abundance of cellulose. This substance leaves a large residue which undergoes a certain amount of fermentation and gives a soft bulky colonic content. On the other hand, concentrated foods which are in large part digested and absorbed and which contain very little roughage provide a fecal mass which is hard and difficult of propulsion and which irritates rather than stimulates the mucosa.

The insistence of a certain type of patient that he have a daily bowel movement at all times, and his consequent use of purgatives, eventually leads to habitual constipation. There often results a vicious circle which is established in the following manner. Normally there remains in the ascending and perhaps a part of the transverse colon after each defecation a certain amount of fecal material which later passes forward to be evacuated the following day; if a drastic purgative has been taken, however, the entire large intestine is emptied and nothing remains for tomorrow's evacuation. Thus, it is evident that the failure of the bowels to move on the morning following a day of purgation is not due, as has been supposed, to temporary paralysis of the intestine, but rather to the fact that there is nothing to move. The patient of whom I write, however, is unhappy without a bowel movement each day and to accomplish this he takes a purgative each night. A normal accumulation of fecal material is not permitted, and the continued purgation injures the intestine. A vicious cycle is established, and chronic constipation results.

In other ways also psychic influences may promote constipation, for in neurotic persons the mere fear that the bowels will not act is in itself sufficient to inhibit normal defecation. This in turn leads to the use of purgatives and the vicious circle above described. Many psychiatrists, notably Déjerine[14] and Dubois,[13] have emphasized this influence. It is well known that the constipated neurotic person will sometimes have normal daily bowel movements when put to bed and given the usual rest treatment. The first thing to do is to explain to such a person that failure to have a bowel movement for one or perhaps two days is not after all such a bad thing, and that it will not make him sick. He should learn that if he can get over his fear of constipation its cure will be less difficult.

Hygiene and Diet.—In giving instructions to the patient, attention should be directed first to matters of hygiene. Regularity of habit is essential. The patient should go to the toilet at a definite time of day; after breakfast is best. It is important that he not be in a hurry, and it would be well if he would read the newspaper at this time. For many men the smoking of a cigar brings that degree of comfort and relaxation which favors proper and well coordinated reflex action. The patient should be comfortable and the toilet should be agreeably warm. A proper stooped over position which will permit the abdominal muscles full action is of help, and to this end a footstool is often advisable. This applies particularly to children, who should never be permitted to sit on a toilet with their feet dangling over.

The diet is of the utmost importance. Its requirements are simple and easily stated. The food should be sufficient in amount and should contain an abundance of roughage. This is provided by a diet which contains a relatively large amount of vegetable foods. On page 113 is a table which gives the cellulose content of the various vegetables, from which may be chosen foods suitable for the correction of constipation. Briefly, the leafy vegetables, such as lettuce, spinach, cabbage and cauliflower are most important; asparagus, tomatoes, onions and the legumes are also good. The fruits are always valuable—apples, pears, oranges and grapes. Dried fruits, such as figs, raisins and prunes, are also good; when cooked they make a delicious dish to be eaten with breakfast foods and cream. Honey and the various preserved fruits have a mildly laxative effect.

It is the custom to prescribe whole wheat bread because of the laxative effect of the outer covering of the grain. This is of distinct advantage, and yet I much prefer to permit the patient the more palatable white bread and to instruct him to take as a breakfast food each day a dish of bran; in this way the same amount of roughage is obtained. It is not necessary to prescribe the more elegant and expensive forms of bran which are put on the market in fancy packages. The bran which we feed the cow properly washed is just as good.

Fats are of considerable help. The fatty acids, when not excessive in amount, have a stimulating effect on the mucous membrane, but too much fat will cause diarrhea or perhaps diarrhea alternating with spastic constipation. Fats are best given in the form of cream, butter, bacon and oil dressings.

The statement that milk is constipating is, I believe, a slander against a very important food. The only objection to milk is that the patient who takes it in large quantities is less likely to eat other foods in amounts sufficient to give him the necessary roughage. It is proper to give the constipated patient milk, provided he obtains from his other foods sufficient cellulose.

Meats, eggs, fish and other more concentrated foods have a proper place in the dietary of constipation, but the patient should take these foods merely in order to meet his nutritive requirements and should fill in with green vegetables.

Occasionally we encounter the constipated patient who is handicapped by some stomach disease which prevents his eating the type of diet just advised. Gastric ulcer complicating the constipation of chlorosis furnishes an example of this. In such cases considerable ingenuity is required of the physician in order to prescribe a diet which will protect the stomach and at the same time properly stimulate the bowel. Vegetables cannot be given except perhaps in the form of purees, and even then their use is questionable. Of great value here is agar. Its soft consistency is such that it will not injure the mucous membrane of the stomach, and yet through the absorption of water it will give to the bowel the proper bulk; it can be used with impunity. Mineral oil also is often of help in establishing normal habits.

Hurst has recently written an excellent monograph on constipation and allied disorders.[9]

MENUS FOR PATIENTS WITH CHRONIC CONSTIPATION*

I.

7:00: 1 glass orange juice and 1 glass hot water

Breakfast:
  1 shredded wheat biscuit with rich milk
  A few prunes
  Bran muffins with honey
  Bacon

Dinner:
  Roast beef, scalloped tomatoes
  Spinach
  Cabbage and celery salad
  Corn muffins, buttermilk
  Baked apple with cream

Supper:
  1 egg omelet
  Buttered celery, steamed cabbage
  Whole wheat bread, butter
  Lettuce salad with Thousand Island dressing
  Buttermilk or sweet milk
  Prune whip

Bedtime:
  3 or 4 figs, dates or raisins

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* Quantities are not specified in the following menus. This depends upon the individual patient's nutritive requirement, and the physician should prescribe accordingly.

II.

7:00 a. m.: 2 glasses hot water with lemon juice

BREAKFAST:
- Kellogg's all bran with cream and stewed fruit
- 1 scrambled egg, whole wheat muffin, honey and butter

DINNER:
- Roast lamb
- Buttered cauliflower
- Asparagus on toast
- Tomato salad with mayonnaise
- Apple tapioca pudding with cream
- Corn or bran muffins
- Buttermilk

SUPPER:
- Vegetable soup
- Baked potato eaten with skin
- Butter
- Scalloped corn
- Steamed fig pudding, lemon sauce

BEDTIME:
- Some dried fruit, 2 or 3 biscuits

III.

7:00 a. m.: Hot water with lemon juice

BREAKFAST:
- Whole wheat cereal with cream
- Prune or apple sauce
- 1 egg omelet with tomato
- Bacon
- 2 bran muffins, butter; honey or preserves

DINNER:
- Baked fish with tomato sauce
- Whole hominy
- Boiled cabbage
- Apple-celery salad with nuts
- Corn muffins or whole wheat bread, butter
- Stewed figs with cream

SUPPER:
- Scalloped oysters
- Green or field peas
- Buttered onions
- Celery and olives
- Bran muffins with butter or bran waffles
- Hot tea

BEDTIME:
- One orange or dried fruit

IV.

7 a. m.: Hot water and lemon juice

BREAKFAST:
- Shredded wheat biscuit with rich milk
- Dried beef frizzled
- 1 soft boiled egg
- Bran muffins with butter and preserves

DINNER:
Vegetable soup, triscuits
Veal roast with dressing
String beans
Spinach salad with mayonnaise
Corn muffins or white bread
Apple snow
Buttermilk
SUPPER:
Puree of peas with bran crackers
2 egg omelet, bacon
Scalloped cabbage
Tomato and celery salad with mayonnaise
Stewed apricots
BEDTIME:
Stewed fruit with Kellogg's all bran and cream

V.
7:00 a. m.: Hot water (2 cups) with lemon juice
BREAKFAST:
Pettyjohn with cream
Stewed peach
Scrambled egg with tomato
Whole wheat or plain muffins with butter and marmalade
DINNER:
Swiss steak
Scalloped onions
Turnip greens with turnips
Raw carrot salad with mayonnaise
Rice pudding with raisins, cream
Bread and butter
SUPPER:
Scalloped eggs
Baked stuffed (with celery) tomato
Whole hominy
Cabbage salad
Whole wheat muffins, prune souffle
BEDTIME:
Triscuits and glass orange juice

VI.
7:00 a. m.: Hot water with fruit juice
BREAKFAST:
Bran with stewed fruit and cream
Panned oysters on toast
Bread and butter, preserves
DINNER:
Meat loaf with gravy
Scalloped corn
String beans
Celery and olives or tomato salad
Corn muffins, butter
Baked apple with cream

Supper:
  Lamb stew with vegetables
  Baked potato eaten with skin
  Dried lima beans
  Cold slaw
  Bread and butter
  Peach whip
Bedtime:
  Triscuits and orange juice or stewed fruit

VII.
7:00 a. m.: Hot water with lemon juice
Breakfast:
  Rolled or cut oats with stewed fruit
  Soft boiled egg, bacon
  Bran muffins, butter, marmalade
Dinner:
  Meat or fish
  Stewed onions
  Spinach or greens
  Stuffed (with celery) tomato salad, mayonnaise
  Corn bread, butter
  Jello with whole cream
Supper:
  Minced meat on toast
  Stewed celery
  Baked beans
  Lettuce salad, French dressing
Bedtime:
  Bran with cream and stewed fruit

High fat diets for the cure of constipation have been used with apparent success at the Mayo Clinic.[14] These diets contain approximately 164 Gm. of carbohydrate, 66 Gm. of protein and 224 Gm. of fat, of which the food value is 3,026 calories. The following foods are included in the daily menu: 100 Gm. of 5 per cent vegetables, half of which is taken raw; 100 Gm. of raw or cooked fruits; 50 Gm. of orange juice; 200 Gm. of baked potato; 60 Gm. of white bread; 2 eggs; 20 Gm. of broiled bacon; 50 Gm. of milk; 50 Gm. of butter; 460 Gm. of 20 per cent cream; 45 Gm. of mayonnaise; 20 Gm. of cereal; 15 Gm. of sugar; 200 cc. of coffee; 1,000 cc. of water. Miss Smith writes:

> Usually from three to five days are required to establish normal bowel habits. The most obstinate case in the entire series, required fourteen days. The fuel value of the high fat regime diet makes it particularly suitable for undernourished patients. Care must be taken to serve the food in a palatable, attractive condition. The milk and cream in the diet may be served in cream soups, cocoa, malted milk, eggnogs and ice cream. Warm, visible fat often disgusts the patient but fat served very hot or very cold will be taken in amounts up to 250 grams daily when high fat feeding is desirable. In planning such diets the vitamin and mineral content of the food selected must not be overlooked.

Such high fat diets are unquestionably of value in selected cases. There are, however, many constipated patients, perhaps the majority, who do not take fats well and who would be upset by such a diet. I have patients of this type who experience alternating diarrhea and obstinate constipation when they eat liberally of fats. The undigested fats irritate the mucosa and set up a colitis which interferes with normal bowel movements.

INTESTINAL AUTO-INTOXICATION

Intestinal auto-intoxication is a term of uncertain meaning which has been vaguely applied to a wide variety of symptoms believed to come from the absorption of poisons from the alimentary tract. There is much to suggest that poisons elaborated in the intestinal tract may enter the circulation and be injurious, but in substantiation of such a belief there are few facts that will stand critical scrutiny. There are many such hypothetical poisons; among them are: (1) the products of normal digestion, such as peptones or fatty acids; (2) putrefactive products, such as indol, skatol and phenol, which may come from protein decomposition; (3) fatty acids and other bodies which may come from carbohydrate fermentation, and (4) synthetic products of bacterial activity.

It is impossible in a short space to discuss the evidence for or against a possible poisoning by these products. Most people who speak of intestinal auto-intoxication have no clear idea as to just what they mean. As a rule, they have in mind the products of protein decomposition, as evidenced by the presence of indican in the urine. Suffice it to say that in spite of a voluminous literature, most of it conjectural, some of it experimental, no one has been able to show that indicanuria has any far-reaching clinical significance. The evidence in support of other forms of poisoning from intestinal decomposition products, whether from protein, carbohydrate or fat, is equally uncertain. The body has two effective lines of defense which prevent ready access of intestinal poisons to the general circulation: first, the intestinal mucosa and second, the liver. Under normal conditions, the vast majority of poisons which may be absorbed from the intestinal tract are destroyed by one or the other of these defensive organs.

We are therefore forced to conclude, at least tentatively, that while unquestionably there are formed in the intestinal canal chemical bodies which are poisonous when introduced experimentally in large amounts into the general circulation, there is no clear evidence, clinical or experimental, that this form of poisoning is a potent source of disease.

The *passage of bacteria* themselves through the intestinal wall is probably a much more prolific source of trouble. It has been shown that such bacterial invasion, to which Adami has given the term latent or subinfection, is a fairly frequent occurrence.

Since the nature of the poison, if there is any, which is responsible for so-called intestinal auto-intoxication is uncertain, dietary precautions directed against it are difficult to formulate. When trouble of this nature is suspected, the stools should be studied according to the Schmidt method, and dietary corrections made accordingly. When there are evidences of intestinal putrefaction and poor digestion of meat, a protein-poor diet should be advised. If there are evidences of poor carbohydrate utilization, a carbohydrate-poor, protein-rich diet should be prescribed. If it seems desirable to change the nature of the intestinal flora, this can best be accomplished by confining the patient for a time to *Bacillus acidophilus* milk, to which has been added relatively large amounts of lactose. He can be kept on this type of diet (2 quarts daily) for a week or ten days, after which cereals, preserves and other foods should be added. For a complete discussion of intestinal auto-intoxication with a critical review of the literature, the reader is referred to a recent article by Alvarez.[15]

DISEASES OF THE LIVER

Because of its intimate relationship to many different phases of metabolism, the liver is the most important of all the organs concerned in the elaboration of food. Its disease may demand dietary adjustment from three different angles: 1. Failure of any of its several regulatory functions will lead to profound metabolic disturbances, some of which can be anticipated and at least in a measure prevented by diet. 2. Lack of bile in the intestinal tract will unfavorably influence digestion and absorption. 3. Venous congestion, such as accompanies obstruction to the portal circulation, will interfere with the secretory and motor activity of the intestinal tract. Consideration of the functions of the liver should therefore precede any discussion of diet. This includes the relation of the liver to protein metabolism, its control over carbohydrate metabolism, its rôle in the utilization of fat and the formation of bile.

The liver is of great importance to protein metabolism. This has been well illustrated in the experiments of Mann,[16] who has shown that after hepatectomy there is an immediate cessation in the production of urea, and (provided the kidneys are competent) a marked fall in the urea content of blood, tissues and urine. At the same time there is an increase in the uric acid of both blood and urine and a general increase in the amino-acids of the blood. All this seems to warrant the conclusions that the liver is the chief if not the sole organ which converts protein cleavage products into urea, that it destroys uric acid, and that it controls the utilization of amino-acids.

Of even greater importance perhaps is the controlling influence which the liver exerts over carbohydrate metabolism. Mann has found that dogs which have been subjected to the removal of the liver immediately show a progressive fall in blood sugar, and that they soon develop a characteristic group of symptoms which can be attributed to the hypoglycemia. Untreated they die in a short time. If, however, glucose is given intravenously, the blood sugar returns to normal, and the symptoms for a time disappear. The animal can in this manner be kept in fairly good condition for a while, but there finally appear other symptoms which are independent of the blood sugar, and the animal dies. If the pancreas and liver are both removed at the same time, the results noted above are the same. If, however, the pancreas is removed first and as a result the animal has marked hyperglycemia, the fall in blood sugar after hepatectomy is even more precipitate. It is significant, too, that after the removal of the pancreas the liver cells lose their ability to store glycogen even though there is an excess of sugar in the blood, and that this function is restored by the administration of insulin. Carlson,[17] in summarizing the carbohydrate controlling function of the liver, writes:

> The liver produces some substance other than sugar necessary for the correlation of the blood sugar and tissue sugar; or else in the absence of the liver, toxic substances develop in the blood and tissues, and upset the normal mechanism serving to maintain a fairly regular level of blood sugar.

The liver has the power also of preparing the fats for utilization by the tissues. It is interesting too, that when there is diminished storage of glycogen in the liver its stores of fat are increased.

The pigment-forming function of the liver has been studied by Whipple,[18] who applies the term "pigment complex" to a group of substances found here which are essential to the formation of mature body pigments. He believes that these substances are intimately concerned in the manufacture of hemoglobin, and one must conclude from his work that interference with this function will lead to a disturbance of blood regeneration. It was on this work that Minot and Murphy[19] based their discovery of the value of liver-feeding in pernicious anemia. In the formation of bile, the liver probably acts both as a secretory and an excretory organ. As far as the bile pigments are concerned (bilirubin, biliverdin and urobilin), it is probable that they serve no useful purpose, and that they are thrown into the intestinal tract merely as excretory products. If there is obstruction to the outflow of the bile, these substances accumulate in the blood and give to the tissues the yellow color which is characteristic of icterus.

The story of the bile salts is different, for they are of definite value to the animal. They are synthesized in the liver as glycocholic and taurocholic acids and appear in the bile as their sodium salts. On being thrown into the intestinal tract, they are rapidly reabsorbed and again appear in the bile. There is evidently in the liver some finely adjusted mechanism which controls the production and destruction of these salts, but the nature of this mechanism is unknown. The chief interest which bile acids (and their salts) hold for us is their influence in promoting the utilization of fat digestion and in retarding intestinal putrefaction. Whether these same acids are concerned in endogenous fat metabolism as it takes place in the liver, is unknown.

The flow of bile into the intestine is necessary to life, for experiment has shown that dogs with bile fistula, unless they are given bile by mouth, or unless a tiny fistulous tract into the duodenum persists, will die within a short time. However, and this is of importance from a nutritional standpoint, a properly adjusted diet will greatly prolong the life of these animals. If they are given milk, rice, bread and cooked potatoes, instead of dying within two months, they will live in fair condition, according to Whipple,[20] for from four to ten months, and eventually die of certain bony abnormalities.

Further evidence of the influence of diet in compensating for the handicap of liver impairment was seen in the hepatectomy experiments of Mann[21] quoted above.

> He found that he could remove up to an estimated 70 per cent of the dog's liver and that the power of this organ to regenerate and hypertrophy, is such that a few weeks later the animal has the same amount of liver tissue as before operation. He found, however, that the ability of the liver to restore itself after surgical removal depended to a great extent upon an intact portal circulation. When the portal blood is shunted from the liver, the restoration of hepatic tissue after removal occurs to only a slight extent, and a permanent reduction in hepatic tissue is produced. Animals with an Eck fistula and permanently reduced hepatic tissue will remain in normal appearing condition for many months but only when their diet is carefully controlled. A diet which includes a small amount of protein and a large amount of carbohydrate was found to be best suited to their needs.

The flow of bile and the nature of its constituents is profoundly influenced by diet, for the hepatic cell is very versatile and the composition of the bile under varying influences is not necessarily always the same. Sugar inhibits the output of bile salts and diminishes the total quantity of bile. The feeding of meat, on the other hand, leads to an increased flow of bile and to an increased amount of bile salts, while it decreases the output of bile pigments. The only cholagogue of real importance, however, is the bile salt. Whole bile or the bile salts when given by mouth will cause an increase in the flow of bile with a marked increase in the output of bile salts. The various drugs which have been heralded as efficient cholagogues, such as calomel and the salicylates, have been found to be without influence when subjected to the scrutiny of animal experiment. Whipple, on the basis of his experiments, concludes that: "The only active cholagogues are bile or bile salts."

The gallbladder from a nutritive standpoint is an organ of very little importance. It can be removed with impunity. The only function ascribed to it with any degree of certainty is the concentration of the bile which comes to it. Most of the bile, however, probably flows direct from the liver into the duodenum without reaching the gallbladder. It is only when this organ becomes infected that it is of clinical interest or demands dietetic consideration.

Dietary Regulation.—The results of animal experiment cannot always be applied unreservedly to man, but the nutritional disturbance seen in animals following removal of the liver or diversion of the bile flow, and the direct manner in which these disturbances can be influenced by diet, is all so clear that its clinical application is obvious.

While the different diseases to which the liver is liable are entitled in some small measure to separate consideration, there are certain dietary rules which apply to all liver impairment whatever its cause. In arranging the diet, consideration must be given, (*a*) to the nature of the functional impairment, for the several functions of the liver are not necessarily impaired in similar degree; also, (*b*) to the fact that intestinal disturbances, both secretory and motor, with resulting indigestion, may result from failure of biliary secretion or congestion of the mucosa.

The protein intake, especially as regards meats, should always be limited. The objections to a high-protein diet in liver disease are three fold: the injured liver may be unable properly to metabolize protein cleavage products; the absence of bile from the intestinal tract favors putrefaction; and regeneration of damaged parenchyma takes place much more rapidly with a low-protein intake. True, the feeding of meat will increase the output of bile but the same can be accomplished merely by giving bile salts by mouth. The patient must always, however, be permitted a certain minimal amount of protein, say from 0.75 to 1 Gm. daily per kilogram of body weight. This is best given in the form of milk, 1 liter of which will provide about 40 Gm. of protein, which, together with the proteins from other sources, will probably be enough to meet his minimal needs. Therefore, meat should be omitted from the diet altogether, or the patient should be given merely one small helping two or three times a week. Eggs, one or two daily, may occasionally be permitted. Broths and meat soups should be avoided.

An abundance of carbohydrate is desirable whenever there is impairment of liver function. This value of carbohydrate is well illustrated in the fact, related above, that an animal which has been deprived of his liver will live much longer if given glucose. True, the administration of sugar in large amounts lessens the output of bile acids, but the administration of bile salts by mouth will overcome this effect. The carbohydrate should always be in the form of bland, easily assimilated foods. A reasonable amount may be given in the form of preserves, orange marmalade, honey and other sugary foods, but too much sugars irritate the stomach mucosa and interfere with the digestion. The bulk of the carbohydrate should be in the form of cereals with cream, rice and butter, toast, mashed potatoes, and other bland, non-irritating foods.

Fruit juices, particularly orange juice and cooked fruits, are good. As a rule, however, raw fruits, leafy vegetables and other bulky foods, because of the accompanying intestinal disturbances, are not well borne. It is frequently advisable, however, because of their vitamin content, to give tomatoes, either fresh or canned. The lack of roughage which such a concentrated diet involves may interfere with peristalsis of the colon, but this can be overcome in large measure by the administration of agar.

A certain amount of fat is necessary in order to provide the required calories; otherwise the diet will be bulky. It should be given preferably as cream, butter and yolk of egg. A little bacon is sometimes permissible, but as a rule other fats are not well borne. The administration of bile salts by mouth will aid in the emulsification and absorption of the fat. Whether by this means the elaboration of fat in the liver can be improved is uncertain.

Biliousness.—This term has been widely used, especially in the South, to denote almost any condition in which the patient's sense of well-being is disturbed. As ordinarily applied, it most often means chronic gastritis. It has been applied to such widely unrelated conditions as pregnancy, chronic tonsillitis, alcoholic gastritis, chronic nephritis, latent malaria, early typhoid fever, tuberculosis and catarrhal jaundice.

MENUS FOR PATIENTS WITH LIVER DISEASES

I.

Breakfast:	1 medium baked apple with cream
	Average helping oatmeal with cream and sugar
	2 slices toast with butter and marmalade
	1 cup coffee, half milk and sugar or
	1 cup cocoa or milk
10:00 a. m.:	1 glass fruit juice
Dinner:	1 shirred egg
	1 heaping tbsp. mashed potatoes
	2 slices toast with butter
	Stewed tomatoes
	Generous helping rice pudding, with cream
	1 glass milk
4:00 p. m.:	1 glass milk
Supper:	1 slice cream toast
	A. h. rice with butter
	2 slices toast, butter
	A. h. apple tapioca with fruit sauce or cream
	1 glass milk
Bedtime:	1 glass orange juice

II.

7:00 a. m.:	Cup hot water with lemon juice
Breakfast:	Dish of prunes with cream
	A. h. Farina with cream and sugar
	1 soft boiled egg
	1 or 2 slices toast with butter and honey
	1 cup hot milk with coffee
10:00 a. m.:	1 glass milk
Dinner:	A. h. scalloped potatoes
	Baked stuffed (with bread crumbs) tomato
	2 slices toasted whole wheat bread, butter
	A. h. bread pudding with fruit sauce or cream
	1 glass milk
4:00 p. m.:	1 glass buttermilk
Supper:	A. h. spoon bread (grits, cornmeal, eggs, salt, and milk) baked
	A. h. baked spaghetti and tomato, and a bit of cheese
	A. h. tapioca cream pudding
	1 slice toast, butter
	1 glass milk
Bedtime:	1 glass fruit juice

III.

7:00 a. m.:	1 glass orange juice or hot lemonade
Breakfast:	A. h. cream of wheat with cream and sugar
	2 toasted muffins, butter and marmalade
	1 cup cocoa
10:00 a. m.:	1 glass milk

Dinner: A. h. baked macaroni (without cheese) with eggs and milk
A. h. mashed carrots with butter
Stuffed pepper with rice and bread crumbs, seasoned
A. h. prune whip (use whipped cream instead of egg white)
2 slices toast, butter, 1 glass milk
4:00 p. m.: 1 glass of junket
Supper: A. h. grits or cream of wheat with butter
1 shirred egg
A. h. stewed tomatoes
A. h. peach sauce
2 slices toast with butter, milk
Bedtime: 1 glass orange juice

IV.
7:00 a. m.: Cup hot water with lemon juice
Breakfast: A. h. apple sauce
A. h. cereal with cream and sugar
Cream toast with ½ grated hard boiled egg
Toast, butter, preserves
1 glass milk or cocoa
10:00 a. m.: 1 glass orange juice
Dinner: Panned or creamed oysters (six) on toast
A. h. rice with butter
A. h. well cooked young carrots or turnips creamed
Toast, butter
A. h. apple tapioca with cream
1 glass milk
4:00 p. m.: 1 glass milk
Supper: 1 egg omelet, a. h. grits with butter
A. h. dish stewed tomatoes
Toasted muffins with butter
A. h. Spanish cream with whipped cream
1 glass milk
Bedtime: Hot lemonade

V.
7:00 a. m.: ½ glass orange juice
Breakfast: A. h. cereal with cream and sugar
Toasted muffins, butter, marmalade
1 cup cocoa or milk
10:00 a. m.: Baked apple with whipped cream
Dinner: 1 shirred egg
Baked stuffed tomato
Potato puff
Toast and butter
Ice cream, glass milk
4:00 p. m.: 1 glass milk
Supper: A. h. baked macaroni with tomatoes
a. h. well cooked young carrots, creamed
Toast with butter
A. h. fruit pudding with cream
1 glass milk
Bedtime: 1 glass hot lemonade

VI.
7:00 a. m.: Hot water with fruit juice
Breakfast: A. h. stewed fruit
A. h. oatmeal with cream and sugar
Cream toast with 1 crisp slice bacon
Toasted muffin, butter, honey or preserves
1 cup coffee with hot milk
Sugar
10:00 a. m.: Fruit punch
Dinner: 1 spoon macaroni and cheese, small amount stuffed pepper
A. h. well cooked new turnips, creamed
Toasted rolls with butter
A. h. chocolate pudding with cream
1 glass milk
4:00 p. m.: 1 glass buttermilk
Supper: Scrambled egg with tomato
Stuffed baked potato
A. h. well cooked chopped spinach
A. h. lemon milk sherbet
Toast, butter, milk
Bedtime: 1 glass orange juice

VII.
7:00 a. m.: 1 glass orange juice
Breakfast: A. h. cream of wheat with sugar and cream
A. h. broiled tomatoes
Toast, butter, stewed fruit
1 cup milk, coffee with milk, or cocoa
10:00 a. m.: Fruit juice
Dinner: Small serving chicken or lamb, very tender
A. h. rice with butter
Baked stuffed tomato
Toast, butter
A. h. rice pudding, with sauce or cream
1 glass milk
4:00 p. m.: Stewed fruit with toasted muffin, butter
Supper: A. h. spoon bread
Baked potato with butter
A. h. mashed carrots with butter
Toast with butter
A. h. baked egg custard, milk
Bedtime: Hot lemonade

Catarrhal Jaundice.—This term probably embraces several different pathologic states; it usually means an obstructive inflammation of the bile passages. Not infrequently it is the sequel or accompaniment of an acute gastro-duodenitis, the infection of which has passed from the duodenum through the duct to the liver. In other instances it is a blood borne infection of unknown nature.

If it is accompanied by gastritis, if there is much fever, or if the prostration is great, it is best for the patient materially to restrict his activities. In a few instances rest in bed in the beginning is best.

The diet should be simple and nonstimulating. Milk should be the chief article, to which may be added cereals with cream, milk toast, rice with butter and mashed potatoes. Fats should be restricted. After about ten days it is usually permissible to add eggs and tender meats. It is best at all times to avoid broths and meat soups. Fruit juices and cooked fruits are permissible later in the disease, but raw fruits and green vegetables should at all times be avoided. All highly seasoned foods of every kind—pepper, sauces, fried foods and complex made dishes such as croquettes—should be avoided. Care should be taken to see that the patient gets enough food to meet his nutritive requirements.

In the more chronic forms of the disease, dietary restriction need not be so rigid. Milk and cereals with stewed fruits should constitute the bulk of the diet, but tender meats, soft eggs and the simpler vegetables should also be permitted. Simple desserts, such as rice or tapioca pudding, custards and gelatin preparations may also be taken.

Intimately related to dietary regulation is the question of laxatives. Mild laxatives are good, but drastic purgatives are bad. Carlsbad salts or sodium phoshate taken in a full glass of hot water will often prepare the digestive tract for breakfast. I doubt that Lyon's method of injecting magnesium sulphate through a duodenal tube possesses any advantage over the administration of the same salt by mouth. Gastric lavage is often of benefit in chronic jaundice, perhaps because it combats the frequently accompanying gastritis. Bile salts should always be given because of their powerful cholagogue action.

MENUS FOR PATIENTS WITH CATARRHAL JAUNDICE

I.
7:00 a. m.: Hot water with lemon juice
BREAKFAST:
  Average helping oatmeal with cream and sugar
  Milk toast
  1 cup cocoa
10:00 a. m.: 1 glass milk
DINNER:
  A. h. mashed potatoes
  2 toast, very little butter
  A. h. Spanish cream with whipped cream
  1 glass milk
4:00 p. m.: A. h. well cooked rice with milk
  1 toasted muffin, tsp. butter
  A. h. jello with cream
  1 glass milk
BEDTIME: 1 glass milk

II.
7:00 a. m.: Glass hot water with fruit juice
Breakfast:
A. h. well cooked Farina with cream and sugar
Cream toast
1 cup cocoa or milk
10:00 a. m.: 1 glass milk
Dinner:
Baked potato or rice with butter
Toast, butter
1 glass milk
4:00 p. m.: Toast, 1 glass milk
Supper:
A. h. creamed macaroni
2 toasted muffins, butter
A. h. tapioca cream
Bedtime:
A. h. corn meal gruel with cream and sugar, milk

III. More liberal after 10 days
7:00 a. m.: Hot water with fruit juice
Breakfast:
A. h. cream of wheat with sugar and cream
Milk toast
1 cup cocoa or milk
10:00 a. m.: A. h. apple sauce, toast, glass milk
Dinner:
Small serving tender meat
Baked potato
Toast, butter
A. h. Spanish cream with cream, milk
4:00 p. m.: Ice-cream, glass of milk
Supper:
1 coddled egg
A. h. rice with butter
2 toasted muffins, butter and jelly
A. h. apricot whip (use cream)
1 glass milk
Bedtime:
A. h. prune whip, glass milk

Syphilis of the Liver.—This is probably a much more frequent disease than is commonly supposed.[21] The diet should conform to that recommended above for liver diseases in general. The degree of restriction should depend largely on the extent of injury of the parenchyma and the amount of functional disturbances.

Cirrhosis of the Liver.—In any of its stages, this condition demands rigid dietary restriction. Faulty dietary habits should be corrected;

the patient should be warned especially against the use of highly seasoned foods, such as those which contain pepper, mustard or other condiments. He should abstain completely from alcohol. The general dietary rules and menus given above for all forms of liver impairment apply to cirrhosis. Nothing can be added to what was said there.

Salines should be administered liberally but not in amounts sufficient to weaken the patient. Sodium phosphate or carlsbad salt taken in a full glass of hot water a half hour before breakfast or three times daily before meals is frequently good.

To prevent reaccumulation of ascitic fluid after it has been aspirated, a rigid milk diet has been advised. The Karell milk cure as devised for patients with heart disease (see page 626) is possibly suitable, although because of the customary purgation in cirrhosis of the liver, it is advisable to give more fluids than this diet permits, say from 2 to 3 liters of milk daily. A salt-free diet has also been used with success, and I am inclined to think that it is superior to the milk diet. The patient should be told to add no salt to the food after it comes to the table, to take unsalted butter and to eat no unusually salty foods. Such a diet provides about 2 Gm. of sodium chloride daily. For brief periods, say two or three days at a time, the more rigid "salt-free" diet may be used, for which all of the food, even the bread, is prepared without salt. This diet provides about 0.5 Gm. of sodium chloride daily.

Tumors, Abscess and Cysts.—These conditions of the liver demand the diet advised above for liver diseases in general. The extent of the restriction should depend largely on the degree of functional impairment.

Disease of the Gallbladder.—The gallbladder is a relatively unimportant appendage, which becomes of clinical interest only when it is infected or when it harbors a stone which causes trouble. The presence of a stone is not in itself of great moment, unless the irritation caused by it leads to infection or unless it stops the flow of bile. Since cholelithiasis, however, usually means cholecystitis as well, operation for the removal of the stone and drainage or removal of the gallbladder is usually advisable. This is not the place to discuss the technique of gallbladder drainage according to the method of Lyon, or the benefits to be derived therefrom. I know of no experimental data which would lead one to believe that in this manner the flow of bile can be increased, and in my own experience I have been unable to find, after discounting the psychic element, that this procedure is of clinical value.

The diet for patients with cholecystitis is that which would be suitable in chronic or subacute gastritis (page 497). Milk, cereals, milk toast, toast, zwieback, cooked fruits, rice and mashed potatoes should be taken during the acute stage. Occasionally eggs are well borne from the beginning. When the inflammatory reaction is less acute, tender meats and the simpler vegetables may be added. All highly seasoned foods, fried foods and pastries should be avoided.

DISEASES OF THE PANCREAS

The dietary regulation of pancreatic disease depends on the extent and nature of the functional disturbance rather than on the character of the disease itself. Since this organ is concerned with the production of digestive ferments, anything which interferes with this function will also interfere in greater or less degree with the digestive processes of the intestinal tract. Therefore, in constructing a diet for the patient with pancreatic disease, the chief question concerns the resulting digestive impairment. Numerous methods have been devised for determining the degree of failure of the several pancreatic ferments. The ferment activity of the duodenal contents obtained through a duodenal tube is believed to give information of value;[22] also the amount of trypsin and of diastatic ferments in the feces can be determined in vitro with a fair degree of accuracy by appropriate tests. The tests for urinary diastase are of doubtful value. Kashiwado's[23] modification of Schmidt's nucleus test is probably of some value. The most reliable and perhaps the easiest method, however, of ascertaining the degree of functional impairment of the pancreas is to give the test diet of Schmidt and to examine the feces after the manner recommended by him.[24] The necessity for a special test diet has been questioned because information of clinical value can be obtained from the examination of almost any specimen of feces. I am sure, however, that more uniformly reliable conclusions can be drawn from the feces which come from the test diet. This diet was given in detail in the section on intestinal dyspepsia (page 537).

The manner in which all three classes of foodstuffs are dealt with in the intestine should be determined, and to this end both macroscopic and microscopic examinations should be made. The most characteristic evidence of pancreatic insufficiency, though by no means always present, is the very large, soft, light-colored stool containing large amounts of undigested fat (steatorrhea); especially characteristic is the "butter layer" of partially hardened fat which sometimes covers the fecal mass. Under the microscope, droplets and balls of fat, present in much greater amounts than in the normal stool, are easily recognized. Evidence of poor tryptic action, especially if there is gastric anacidity, may appear as easily recognizable muscle fibers with distinct striations. If the stomach digestion is normal but tryptic digestion fails, muscle remains can usually be recognized under the microscope as fine splinter-like particles. This presence of undigested muscle fibers in the feces (creatorrhea) after the test meal, in the absence of diarrhea, is always suggestive of pancreatic disease. To explain the variability of the signs of pancreatic insufficiency, Schmidt states that when pancreatic disease follows cholecystitis, there is an early impairment of the fat digesting function, but if it follows disease of the stomach, evidences of protein indigestion will predominate. Disturbances of carbohydrate digestion are not always apparent, although undigested starch granules are often encountered. The presence of glycosuria, or even of a lowered glucose tolerance, may be an additional link in the chain of evidence pointing to disease of the pancreas.

Functional Disturbances.—Such disturbances of the pancreas, independent of organic disease, analogous to functional gastric disturbances, are believed to occur occasionally (achylia pancreatica). The disturbance may accompany achylia gastrica and may possibly play a large part in the so-called intestinal indigestion of gastric origin. The dietary regulation in such cases should depend on the extent and nature of the digestive failure as shown in the feces, and should follow in general that of chronic pancreatitis given below.

Acute Pancreatitis.—This ranges in severity from the mildest, usually unrecognized, inflammatory reaction to a severe illness of the greatest gravity. The former type of case requires only such dietary regulation as would be suggested by the digestive disturbance seen in the feces. At the other extreme, the profound collapse with great abdominal pain and the rapidly fatal course of the disease, may prevent the use of food except perhaps in the form of a little broth milk and fruit juices.

Necrosis of the Pancreas.—This is an extremely serious, usually fatal, form of pancreatitis. If the patient's condition will permit it, surgical treatment comes first. As a rule, no food is permissible because of the complicating peritonitis, but in some instances liquids in the form of milk, bouillon and strained gruels may be given in small amounts.

Chronic Pancreatitis.—Chronic pancreatitis is always subject to dietary regulation, for it is possible in this way to add greatly to the comfort of the patient and perhaps to promote his recovery. The nature of the disease with which the pancreatitis may be associated should in some measure influence the diet. It is often the sequel of cholecystitis or chlolelithiasis, and not infrequently there is achylia gastrica. The association of diabetes with pancreatitis naturally demands a dietary regimen suitable for the former. Ulcer of the duodenum or a perforating gastric ulcer if present should obviously dictate the type of dietary regulation.

The chief indication in the diet of chronic pancreatitis is rigid fat reduction. Butter, cream, fat meats, oil dressings and similar foods should be avoided. As a rule, it is not necessary to skim the milk, but sometimes this may be necessary. Meats should be limited if meat fibers are found in the feces in appreciable amounts. While moderate restriction of other forms of albumen also is desirable, it goes without saying that the patient should be given enough protein to meet his minimal metabolic needs, say perhaps a gram per kilogram of body weight daily. The protein of milk is usually well borne, and for this reason milk should take a prominent place in the diet. Eggs may also be given in moderate amount, say two eggs daily; they had best be taken soft boiled or poached, rather than raw. The various forms of predigested albumen which are on the market are of doubtful value. The diet should consist in large part of gruels, toast, preserves and other easily digested carbohydrates, provided fermentative dyspepsia is not a prominent feature. Fruits and the coarser vegetables had best be avoided except in thoroughly cooked forms, such as compotes and purees. Fruit juices such as orange juice may be taken, as well as baked apples, stewed prunes and similar fruits.

Occasionally a moderate degree of enteritis develops, due no doubt to the presence in the feces of poorly emulsified fats and irritating fatty acids. This complicates the picture and demands even greater care in the selection of the diet. In such cases the diet should be limited largely to milk, cereals and milk toast.

This is not the place to discuss in detail other forms of treatment. It is appropriate to say, however, that the arrangement of the diet is simplified when digestion is aided by the use of pancreatin or some similar pancreatic preparation, and when, in the case of achylia gastrica, liberal amounts of hydrochloric acid are given.

Patients with Carcinoma, Cyst and Other Tumors.—These tumors of the pancreas, when not amenable to surgical treatment, should be given the dietary treatment suitable for chronic pancreatitis.

MENUS FOR PATIENTS WITH CHRONIC PANCREATITIS

I:
6:00 a. m.: Orange juice
8:00: Well cooked cereals with sugar and plain milk
10:00: Soft boiled egg, toast, milk
12 noon: Milk toast
1 spoon apple sauce
2:00 p. m.: Small pat of scraped beef, toast, milk
4:00: Cup puree of corn (cream corn soup strained and thickened) with toasted crackers
6:00: 1 poached egg on toast, glass milk
8:00: Bowl of hot barley gruel with 1 slice toast
Milk may be given during the night.

II:
6:00 a. m.: Orange juice
8:00: Soft boiled egg, toast, preserves, milk
10:00: Cream of wheat with sugar and plain milk
Prune sauce
12 noon: Very tender white meat of chicken, toast, milk
2:00 p. m.: Cream toast, glass milk
4:00: Baked apple with 1 slice toast
Glass milk
6:00: 1 poached egg with cereal and toast, glass milk
8:00: Glass milk, toasted crackers

III:
6:00 a. m.: Glass hot milk
8:00: Cereal with sugar and plain milk, toast, preserves, milk
10:00: Egg on toast, milk
12 noon: Pat of scraped beef, toast, milk
2:00 p. m.: Bowl of oatmeal gruel, toast, milk
4:00: 1 glass orange juice, toast and preserves
6:00: Soft boiled egg, toast, milk
8:00: Baked apple, milk

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SECTION B

DISEASES IN WHICH DIET IS OF VARYING IMPORTANCE

CHAPTER XIX

FEBRILE DISEASES

The food of the patient with fever should meet two major specifications: (*a*) It should contain no article which is harmful, and (*b*) it should be sufficient in amount to cover the metabolic needs. It is best to consider the first of these separately with each type of fever. The second can be discussed with fever in general, for, with a few exceptions, the metabolic needs are the same no matter what the type of fever; they depend on the degree of temperature and the duration of the illness rather than on the cause of the fever.

For the purposes of this book, febrile diseases can be considered in the following manner: first, the nature of the fever, then in detail one typical fever, such as typhoid fever; and, finally, the incidental nutritive needs of the other febrile diseases.

NATURE OF FEVER

Body temperature, as was pointed out by Rubner, is maintained at a fairly constant figure by means of two forms of regulatory apparatus; the one chemical and the other physical. Chemical regulation controls heat production by stimulating or depressing metabolism, while physical regulation acts through bodily movements which produce heat and through other physical factors which govern heat elimination. These physical factors controlling heat loss are: (*a*) radiation and conduction from the skin, and (*b*) vaporization from the skin and the lungs. The blood conveys to the surface the heat generated within the body, and from the surface, in the manner above stated, the excess of heat is thrown off; from which it is evident that changes in the circulation of the blood, such as occur in fever, will interfere materially with the heat regulating process. In health, vaporization of water from the skin and lungs causes about 24 per cent of the heat loss; while circulatory disturbances will influence this factor, they will do so only to a small extent.

Earlier investigators attributed fever solely to increased heat production. This was an error, as was shown by the experiment of Rubner[1] on a starving dog, in which it was seen that after the animal was given a liberal ration of meat, the heat production rose from 100 calories to 189 calories without appreciable elevation of body temperature. Thus it was demonstrated that if the mechanism of heat elimination functions properly, abnormal heat production will not cause fever.

This and many other problems of fever have been elucidated by the brilliant work of the investigators of the Russell Sage Institute of Pathology at Bellevue Hospital. Du Bois[2] tells of comparative calorimetric experiments with a healthy man and a patient who had malarial chills. The former imitated the shivering movements of the malarial chill and thereby was able greatly to increase his heat production, but nevertheless he did not experience any elevation of body temperature; evidently his heat regulating apparatus was equal to the emergency and eliminated the extra heat as rapidly as it was produced. This was in sharp contrast to the behavior of the patient with a true malarial chill. During the period of chill he increased his heat production approximately 200 per cent, but, as was shown by the calorimeter, he did not increase heat elimination; as a result the extra heat was stored in the body, and there was a rise of 2° C. in body temperature. These investigators have been able to show that while there is an increased heat production during fever, this increase is no greater than that experienced during moderate exercise, and that the rise in body temperature is due primarily to interference with heat elimination. Obviously heat production cannot be the chief fault, for increases which normally result from exercise and food greatly exceed those of fever. A rising temperature means increased heat production with faulty heat elimination, and the maintenance of a fixed level of elevated temperature indicates that at this higher level a balance between heat production and heat elimination has been obtained.

A disturbance in water balance as has been demonstrated by Woodyatt[3] and others no doubt plays some part in the production of fever. A water deficit is said to produce a "positive heat balance." To explain this it has been suggested that in the infectious fevers the destruction caused by the toxin increases the affinity of the tissues for water and that the flow of water into the tissues results in reduced blood volume and particularly in less blood in the surface capillaries. This impaired skin circulation curtails loss of heat, while its cooling effect on the nerve terminals reflexly stimulates (through chemical regulation) heat production. Thus there is a lack of balance between the production and elimination of heat, and fever results.

Is the increased metabolism seen in infectious fevers due to the stimulating influence of the higher temperature or to the infection? To answer this Richter[4] quotes certain experiments on a cold blooded animal (frog), in which bacterial invasion increased metabolism 100 per cent without elevation of temperature. Evidently the infection causes the fever.

Du Bois,[5] in an effort to explain the nature of fever, accepts as plausible Liebermeister's theory that in this condition the heat regulating mechanism is adjusted to a higher level, and that under some toxic, neurogenic, or other influence there is a disturbance of the mechanism by which body temperature is maintained and a new level is for a time established. The "thermostat" is set at this higher level, and chemical regulation leads to increased heat production. We can perhaps draw an analogy between this and the "dislocation of the pacemaker" which occurs in paroxysmal tachycardia. When the temperature reaches its maximum, physical regulation again comes into play, and the blood, by means of an improved circulation, warms the skin which in turn throws off enough heat to maintain at this elevated point a fairly constant level of temperature. As fever begins to fall, a readjustment of both chemical regulation and physical regulation takes place; the former is depressed and the activity of the latter is increased.

METABOLISM IN FEVER

The Sage[6] investigators found that, with the exception of pulmonary tuberculosis, the fevers studied by them exhibited a fairly uniform increase in metabolism for each degree elevation of temperature. For each degree centigrade rise in body temperature there was 13 per cent increase in heat production (7.2 degrees for each degree Fahrenheit). The same coefficient of increase was seen by Sturgis[7] in a patient with exophthalmic goiter who had tonsillitis. These figures give testimony to the closeness with which chemical changes in the body follow the laws which govern reactions in the test tube, and Van't Hoff's law seems to hold good here: "With a rise in temperature of 10 degrees centigrade the velocity of chemical reactions increases between 2 and 3 times." Thus an increase in temperature of 3 degrees (from 37 to 40 C. should according to this law be accompanied by a metabolic increase of 30 to 60 per cent, which in practice has been found to be the case. It is relatively easy, as pointed out by Du Bois,[8] to determine from these figures the metabolism of a patient with fever: calculate the normal basal rate and then add 13 per cent for each degree

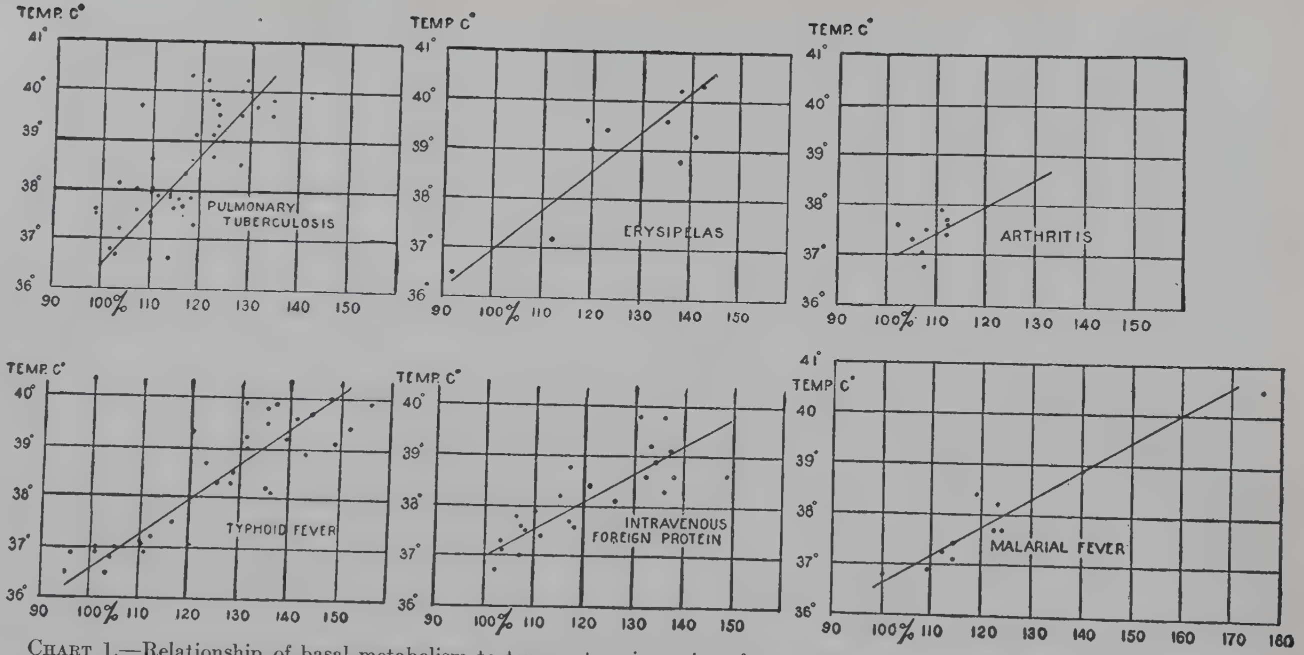

Chart 1.—Relationship of basal metabolism to temperature in various fevers. Ordinates represent rectal temperance in degrees centigrade, abscissas the metabolism expressed in percentages of the average normal; e. g., 150 equals 50 per cent above the average. Each dot represents a calorimeter experiment of from one to three hours at the given temperature. (This chart is taken from Du Bois, E. F.: The Basal Metabolism in Fever, J. A. M. A. 77: 352, 1921.)

elevation of temperature; when there is great toxic destruction of body tissues, add another 10 per cent; if the patient is very restless, add yet another 10 per cent or even as much as 30 per cent.

Protein destruction in fever is always excessive; greater even than in starvation. Kraus[9] estimated that a loss of 500 Gm. of muscle daily in pneumonia is a not infrequent occurrence. Although hyperthermia will cause increased protein destruction, the extent of protein destroyed bears little relation to height of fever; it is more directly dependent on the grade of the infection.

Carbohydrate metabolism is influenced by fever in that the reserves of carbohydrate are burned first; the liver becomes glycogen-poor and the stores of glycogen elsewhere are exhausted.

For a good review of this subject up to 1909, the reader is referred to the article by Richter[4] in Oppenheimer's "Handbuch der Biochemie." Excellent reviews of present day knowledge of fever will be found in Du Bois'[2] "Monograph on Basal Metabolism," in his article in Barker's "Endocrinology and Metabolism"[10] and in an article by him in *The Journal of the American Medical Association.*[8] An exhaustive monograph on heat regulation by Barbour[11] is also pertinent. A large part of our present day knowledge of metabolism in the various fevers comes from the work of E. F. Du Bois and his associates in the Russel Sage Institute of Pathology. Reports of this work are given in their articles on "Clinical Calorimetry" published from time to time in the *Archives of Internal Medicine.*

TYPHOID FEVER

Metabolism.—The metabolic rate of typhoid fever is the same as that in other fevers; that is, for each degree Centigrade elevation of body temperature, there is an increase in metabolism of about 13 per cent. During the height of the disease, the Sage investigators found an increase of approximately 23 to 44 per cent. It is interesting that the youthful patient with typhoid fever shows merely the same metabolic rate per square meter of body surface as does the adult. In explanation of this absence of the increment due to growth, Du Bois offers the suggestion that in typhoid fever a summation of the stimuli of growth and fever does not occur, and that in the youthful patient the latter possibly takes the place of the former.

Carbohydrate metabolism proceeds as in health. There is a distinct difference in the respiratory quotients of patients who are kept on the old type of starvation diets and those who are given the modern high calorie diet; the former show a relatively low respiratory quotient

(0.76), which approaches that of starvation; while the latter give a relatively high quotient, (0.87) even higher than that of the normal subject. The quotient in the latter case is especially high in the early weeks of convalescence (0.95 to 1.00), indicating that at this time there is a retention of large quantities of carbohydrate and perhaps even a storing of carbohydrate in the form of fat. Fat metabolism does not differ from that in health except that when on starvation diets the patient is forced to draw on his stores of body fat.

Protein metabolism differs from that in health in two respects: (*a*) There is great protein destruction, and (*b*) metabolism does not experience from protein its usual specific dynamic action. The increased destruction of protein in this disease is an established fact, but its exact cause is not entirely clear; it is usually ascribed to the toxic action of the infecting agent. The older writers believed that because of this abnormal destruction of protein, it was impossible to maintain the typhoid patient in nitrogen equilibrium, but Shaffer and Coleman[12] demonstrated that nitrogen equilibrium can be maintained in these patients, provided they are given a diet which in caloric value is at least twice the calculated maintenance figure, that is, about 60 to 80 calories per kilogram daily, or from 3,500 to 5,000 calories. The absence of the specific dynamic action of protein can probably be explained in the assumption that the fever impulse takes its place.[13] This is of clinical importance in that it demonstrates that there is no basis in fact for the fear of the older clinicians that a liberal protein intake will stimulate the fever. It has no such influence. We can thus summarize our knowledge of the protein metabolism of typhoid fever: 1. The protein destruction is about three times the "wear and tear" of health, and to cover this the patient should be given not only a liberal amount of protein, but also a total caloric intake which is from 50 to 100 per cent in excess of that necessary in health. 2. The giving of additional protein and other food does not in itself increase the fever.

Pathologic Anatomy.—It should be borne in mind that typhoid fever is a general infection, and that while the chief manifestations are in the intestines, it is in no sense an intestinal disease. The early involvement of Peyer's patches and their subsequent coagulative necrosis with the resulting ulceration is the outstanding feature of typhoid pathology. In the most severe cases the entire lower ileum may constitute one large ulcer with only a few islets of intact mucosa. In addition there are extensive changes in the liver, with disease of the gallbladder and bile passages. All of this interferes with digestion, but, strange to say, to a much less extent than a knowledge of the pathology of this disease would lead one to expect. In spite of all of these changes, the food in typhoid fever is digested and absorbed remarkably well.

Diet in Typhoid Fever. High Calorie Diets.—Until about 1910, it was the custom to give patients with typhoid fever an extremely restricted diet. They were, as a rule, permitted milk to the extent perhaps of 1 liter daily and thin broths. Little effort was made to give them adequate nourishment, and they usually received less than 1,000 calories. Many physicians feared even milk, and gave only broth and fruit juices; the patients approached actual starvation. These diets were given on the assumption (*a*) that even semisolid food might make worse the ulcers in the intestines, and (*b*) that food in liberal quantities would increase the fever. Against the first argument it can be said that the food becomes liquid before it reaches that part of the intestine which shows greatest disease. This fear of even semisolid food is absolutely groundless; milk, for instance, the most appropriate of all foods for typhoid fever patients, becomes semisolid on reaching the stomach. The second reason for the restricted diet—that the food may increase the fever—has through the work of Coleman and Du Bois[13] been shown to be false.

In 1908, Shaffer[14] called attention to the advisability of giving a more liberal diet in typhoid fever, and in 1909 this was further discussed by Shaffer and Coleman.[15] Then in the same year a further article by Coleman[16] brought general recognition of the necessity for a radical change in our method of feeding these patients. He discussed the advantages of a more radical diet in typhoid fever, and advised for a patient of, say 150 pounds' weight, an intake of about 4,000 calories. He stated that in his experience best results had been obtained with a diet containing from 60 to 80 calories per kilogram of body weight or about 4,000 to 5,000 calories daily. To one person he gave 100 calories per kilogram per day, or a total of about 6,000 calories. His experience with this diet was eminently satisfactory; the patients were not so ill as formerly, they were more comfortable, and the duration of the disease was shorter. He stated that a caloric intake which is a little less than that just given would be adequate, and he estimated that as a rule 40 calories per kilogram of body weight is the approximate ideal for the typhoid fever patient.

This author prescribed about 1½ quarts of milk, to which was added from 1 to 2 pints of cream, and from 3 to 6 eggs. He also gave milk toast or dry toast with liberal quantities of butter; milk sugar in large quantities, from ½ to 1 pound, was included because it is less sweet and can be taken in larger amounts than ordinary sugar. Subsequent studies by the Sage investigators[17] showed that these large amounts of food were absorbed during typhoid fever as satisfactorily as in health.

In a subsequent communication in 1917 Coleman[18] discussed at some length his further experience with this high calorie diet. He found that the total duration of the disease in many instances was shortened, and that long convalescence was avoided. Typanities and diarrhea were not nearly as frequent as formerly. There was almost complete absence of the severe nervous symptoms. Great loss of weight was avoided, and complications such as hemorrhage and perforation were less frequent. The mortality of a control group of milk-fed patients was 8 per cent, while that of the patients who were given a more liberal diet was 17 per cent (222 cases in each group).

Coleman reached the following conclusions:

1. The older diets for typhoid fever do not furnish sufficient energy for metabolic exchanges. 2. The amount of food can be determined only by the patient's individual needs. The clinical guides are the weight of the patient and the state of his appetite. In the early stages it is always difficult to give more than, 3,000 calories a day. In the steep-curve period and in convalescence, patients take readily from 4,000 to 6,000 calories a day. 3. The patient cannot take all the food he requires; he should be given all he can digest and absorb. 4. Carbohydrates should furnish the greater part of the diet. The daily protein should not be below 62 Gm. nor greatly exceed 94 Gm. A diet rich in fat may be taken with benefit. In some instances fat has furnished from one-third to one-half of the total energy of the food. 5. The high calorie diet has apparently modified the course of the disease, shortened convalescence and reduced the mortality.

Any one who has had experience with both types of diet will unhesitatingly choose the high calorie diet. During my internship immediately following the Spanish-American war, I saw large numbers of soldiers who had contracted typhoid fever, and in the years immediately following this a great many cases of the disease were seen in the Hillman Hospital in Birmingham. The deplorable state of these patients, whose food was restricted to milk and broth, finds sharp contrast to that of the patients who in more recent years have been given the high calorie diet. Formerly, the dry parched tongue, severe diarrhea, abdominal distention, great emaciation, restlessness, carphologia, subsultus tendinum, muttering delirium and other distressing nervous symptoms often combined to make up the clinical picture. Now we see little of that. The condition of the mouth is better, there is less diarrhea and less abdominal distention, the nervous symptoms are few, the so-called toxemia is much less evident, and the patients, though apathetic, are as a rule comfortable. Carphologia and subsultus tendinum were terms which found frequent place in the older clinical histories, but I doubt if many interns today know what they mean. This striking difference in the condition of patients with typhoid fever then and now may possibly be due in some measure, as has been suggested, to lessened virulence in the strain of infecting organism, but I feel that the big difference is in the diet.

The Construction of the Diet.—The patient should be given relatively large quantities of milk. There are few people who cannot take milk. It does not increase abdominal distention nor does it have the other bad effects which many people, who do not like milk, claim for it. Its use in quantities of 1 to 2 liters daily should be insisted on. Eggs should be given liberally, say from 3 to 6 daily. They should be soft boiled or poached rather than raw; although raw eggs may be given when lack of appetite makes the eating of cooked eggs difficult. Carbohydrate foods in the form of cooked cereals with cream, milk toast, dry toast with butter, honey, milk sugar and small quantities of preserved fruits should be given in liberal amounts. Baked custard, rice or tapioca pudding, well made ice cream, Jello and similar desserts are permitted.

The object of the diet in this disease should be to meet in full the patient's caloric requirements but not necessarily to prevent all protein loss. An intake of from 40 to 50 calories per kilogram daily, in which is included from 1 to 1.5 Gm. of protein per kilogram and an abundance of carbohydrate, is suitable.

Appetite and Care of the Mouth.—Most patients with typhoid fever have no appetite. This is due partly to the disagreeable condition of the mouth. The mouth should be kept scrupulously clean; it should be washed with some agreeable mild antiseptic solution before and after each feeding, and the teeth should be carefully brushed two or three times each day. If this is done and if the patient is given large quantities of water, less trouble from this source will be encountered. The chewing of gum helps to keep the mouth clean and is to be recommended. The high calorie diet itself seems to lessen trouble with the mouth.

It is not out of place here to warn against the older practice of purging these patients. Much of the diarrhea of typhoid fever of former days was due to purgation. Even the so-called initial purge can in critical cases do great harm and perhaps bring disaster. Very mild laxatives may cautiously be used, but ordinarily it is much better to trust entirely to enemas; an enema every second day is sufficient.

During convalescence there should be continued attention to the diet. Although lack of appetite is a rule during the height of the disease, increased appetite is common at this stage. As the fever subsides the patient feels the need of replenishing his lost stores of glycogen and of making up for his protein loss, but if he has been properly fed during the illness he will not be nearly as voracious as the convalescents of former days. It is best to proceed slowly during convalescence and not to permit a food intake which is beyond the patient's assimilative powers.

Intestinal hemorrhage demands that the ingestion of all food should be stopped. The patient should be kept absolutely at rest with an ice bag or other cold appliance to his abdomen and should be given only a little cracked ice by mouth. If the hemorrhage has been copious, nothing further should be given for twenty-four hours. After this, food in the form of small quantities of cold milk may be given cautiously. Gradually this may be increased. Morphine is sometimes necessary to insure complete rest.

Perforation also demands the discontinuance of all foods. Surgical intervention is imperative.

MENUS USED BY THE AUTHOR FOR PATIENTS WITH TYPHOID FEVER

The following dietaries are typical of those which the author has found suitable in typhoid fever. The caloric and protein intake is adjusted to the needs of a patient weighing 70 kilograms. It carries about 50 calories per kilogram, and while it is not sufficient to prevent completely all protein loss, it will prevent the ill effects of the low calorie diet. It may be increased or diminished as circumstances warrant.

I.

20 per cent cream for milk and 40 per cent for cereals

	Calories
7 a. m.	
1 glass malted milk hot or cold	184
1 average sized slice milk toast	213
	397
9 a. m.:	
1 heaping tbsp. farina with 2 tsp. sugar	132
and 2 tbsp. cream	120
⅔ glass milk with 2 tbsp. cream	147
	399
11 a. m.:	
Soft boiled egg	60
1 average slice bread toasted and 1 tsp. butter	149
1 heaping tbsp. tapioca pudding	114
⅔ glass milk and 2 tbsp. cream	73
	396
1 p. m.:	
3 heaping tbsp. boiled oatmeal strained with 1 tsp. butter and	173
2 tbsp. cream	120
1 glass orange juice with 2 tsp. sugar	182
	475
3 p. m.:	
Coddled egg on toast with ½ tsp. butter	169
½ tbsp. preserves or jelly	53
⅔ glass milk with 2 tbsp. cream	147
3 tbsp. junket	85
	454
5 p. m.:	
Milk toast	213
2 h. tbsp. ice cream	189
	402
7 p. m.:	
2 heaping tbsp. cream of wheat	100
with ½ tsp. butter, 2 tsp. sugar and	121
2 tbsp. cream	120
½ glass milk with 2 tbsp. cream	139
	480
9 p. m.:	
8 tbsp. oatmeal gruel with	50
4 tbsp. cream and 2 tsp. sugar	322
⅔ glass milk and 2 tbsp. cream	147
	519
Total calories	3,532

II.

	Calories
7 a. m.:	
⅔ glass milk with 2 tbsp. 20 per cent cream	147
8 tbsp. oatmeal gruel	50
with 2 tbsp. 4 per cent cream	120
2 tsp. sugar	82
	399
9 a. m.:	
Soft boiled egg and 1 average slice toast with ½ tbsp. jelly	186
1 tsp. butter	79
⅔ gl. milk with 2 tbsp. cream	147
	412
11 a. m.:	
2 h. tbsp. Farina well cooked with 2 tsp. sugar and 2 tbsp. cream	302
⅔ glass milk with 2 tbsp. cream	147
	449
1 p. m.:	
Poached egg on 1 average slice bread toasted and 1 tsp. butter	209
1 tbsp. rice custard	89
1 glass orange juice with 2 tsp. sugar	182
	480
3 p. m.:	
1 average slice bread toasted and softened with ½ glass hot milk, ½ tsp. butter	173
1 heaping tbsp. ice cream	94
⅔ glass milk with 2 tbsp. cream	149
	416
5 p. m.:	
Soft boiled egg	60
1 average slice bread toasted with 1 tsp. butter	149
½ tbsp. preserves, no skin or seeds	52
3 tbsp. junket	85
½ gl. malted milk	132
	478
7 p. m.:	
3 tbsp. oatmeal strained	94
with 2 tbsp. cream and 2 tsp. sugar	120 82
⅔ glass milk and 2 tbsp. cream	147
	443
9 p. m.:	
1 glass milk, half cream	240
1 heaping tbsp. soft custard	113
½ slice toast and ½ tsp. butter	74
Total calories 3,484	427

III.

	Calories
7 a. m.:	
1 glass orange juice with 2 tsp. sugar	182
Milk toast	213
	395
9 a. m.:	
3 heaping tbsp. oatmeal, strained	94
with 2 tsp. sugar and 2 tbsp. cream	202
⅔ glass milk with 2 tbsp. cream	147
	443
11 a. m.:	
1 soft boiled egg	60
1 average sized slice toast and 1 tsp. butter	149
⅔ glass milk and 4 tbsp. cream	165
	374
1 p. m.:	
8 tbsp. oatmeal gruel with 2 tbsp. cream and 2 tsp. sugar	252
1 heaping tbsp. baked custard	91
⅔ glass milk and 2 tbsp. cream	147
	490
3 p. m.:	
Poached egg on 1 average slice toast—1 tsp. butter	209
1 glass malted milk	184
	393
5 p. m.:	
2 heaping tbsp. Farina with 1 tsp. butter—2 tsp. sugar	261
and 2 tbsp. cream	120
⅔ glass milk and 2 tbsp. cream	149
	530
7 p. m.:	
Soft boiled egg	60
1 average slice toast, 1 tsp. butter and	149
½ tbsp. marmalade, no skin	53
⅔ glass milk with 2 tbsp. cream	149
	411
9 p. m.:	
1 glass malted milk flip (1 egg)	267
1 heaping tbsp. rice custard with	89
2 tbsp. cream	120
	476

Total calories, 3,512

RECIPES FOR PATIENTS WITH TYPHOID FEVER WHICH THE AUTHOR HAS FOUND USEFUL

		Carbohydrate	Protein	Fat	Calories
Baked Custards					
2 cup milk					
2 eggs					
¼ cup sugar					
2 heaping tbsp. =		20	7	7	84
Boiled Soft Custard					
1 cup milk					
1 egg yolk					
1 tbsp. sugar					
Makes 3 servings—each =		13	4	5	113
Ice-cream					
3 cups milk	⅔ cup sugar				
1 cup cream	Vanilla				
3 eggs	2 heaping tbsp. =	18	5	10	189
Tapioca Pudding					
2 cups milk					
3 tbsp. minute tapioca					
1 egg					
2 heaping tbsp. sugar					
3 heaping tbsp.		22	6	6	176

The menus given below are those of Dr. Coleman.[19]

DIETS OF VARIOUS CALORIC VALUES USED BY COLEMAN

Name	Amount	Calories
Apple sauce	1 ounce	30
Bread	Average slice (33 Gm.)	80
Butter	1 pat (⅓ ounce)	80
Cereal (cooked)	1 heaping tablespoonful (1½ ounces)	50
Crackers	1 ounce	114
Cream (20 per cent)	1 ounce	60
Egg	1 (2 ounces)	80
Egg, white	1	30
Egg, yolk	1	50
Lactose	1 tablespoonful (9 Gm.)	36
Milk (whole)	(1 pint 350) 1 ounce	20
Potato (whole)	1 medium	90
Potato (mashed)	1 tablespoonful	70
Rice (boiled)	1 tablespoonful	60
Sugar, cane	1 lump	16
Sugar, milk	1 tablespoonful (9 Gm.)	36
Toast	Average slice	80

For 1,000 CALORIES A DAY:

Milk, 1 quart (1,000 cc.)	700
Cream, 1⅔ ounces (50 cc.)	100
Lactose, 1⅔ ounces (50 Gm.)	200
This furnishes 8 feedings, each containing	
Milk, 4 ounces	80
Cream, 2 drams	15
Lactose, 6 Gm.	24

	Calories
For 1,500 calories a day:	
Milk, 1½ quarts (1,500 cc.)	1,000
Cream, 1⅔ ounces	100
Lactose, 3⅓ ounces (100 Gm.)	400
This furnishes 6 feedings, each containing:	
Milk, 8 ounces	160
Cream, 2 drams	15
Lactose, 16 Gm	64
For 2,000 calories a day:	
Milk, 1½ quarts	1,000
Cream, 8 ounces (240 cc.)	500
Lactose, 4 ounces (125 Gm.)	500
This furnishes 7 feedings, each containing:	
Milk, 7 ounces	140
Cream, 1 ounce	60
Lactose, 18 Gm	72
For 2,500 calories a day:	
Milk, 1½ quarts	1,000
Cream, 8 ounces	500
Lactose, 8 ounces (250 Gm.)	1,000
This furnishes 7 feedings, each containing:	
Milk, 7 ounces	140
Cream, 1 ounce	60
Lactose, 36 Gm	144
For 3,000 calories a day:	
Milk, 1½ quarts	1,000
Cream, 1 pint (480 cc.)	1,000
Lactose, 8 ounces	1,000
This furnishes 8 feedings, each containing:	
Milk, 6 ounces	120
Cream, 2 ounces	120
Lactose, 1 ounce (30 Gm.)	120
For 3,900 calories a day:	
Milk, 1½ quarts	1,000
Cream, 1 pint	1,000
Lactose, 16 ounces (480 Gm.)	1,900
This furnishes 8 feedings, each containing:	
Milk, 6 ounces	120
Cream, 2 ounces	120
Lactose, 2 ounces	240

The following menus were arranged for Dr. Coleman by Miss Mary E. Sheehan, head nurse in Ward A1 of Bellevue Hospital. They may be followed at any stage of the disease if the patient is capable of taking solid and semisolid food, and if he is hungry, but are most useful in the later stages and in convalescence. The night feedings are given when the patient's temperatures are taken in the course of the ward routine.

MENUS ESPECIALLY ADAPTED FOR CONVALESCENCE

The diet for this day furnishes 3,910 calories.

	Hours	Total	Calories
Milk, 6 ounces	9 a. m.; 1, 3, 7	1,260 c.c.	860
Cream, 2 ounces	10 p. m.; 1, 4	420 c.c.	840
Lactose, 10 Gm.		70 Gm.	280
			1,980

11 a. m.:	Calories
Egg, 1	80
Mashed potato, 20 Gm	20
Custard, 4 ounces	250
Toast (or bread), 1 slice	80
Butter, 20 Gm	150
Coffee	...
Cream, 2 ounces	120
Lactose, 20 Gm	80
	780

5 p. m.:	Calories
Egg, 1	80
Cereal, 3 tablespoonfuls	150
Cream, 2 ounces	120
Applesauce, 1 ounce	30
Tea	
Cream, 3 ounces	180
Lactose, 20 Gm	80
	640

7 a. m.:	
Egg, 1	80
Toast, 1 slice	80
Butter, 20 Gm	150
Coffee	
Cream, 2 ounces	120
Lactose, 20 Gm	80
	510

Milk sugar lemonade may be substituted for the milk mixture at 3 o'clock.

The diet for this day furnishes 5,580 calories.

	Hours	Total	Calories
Milk, 5 ounces	9 a. m.; 11, 1, 3, 7	1,200 cc.	820
Cream, 2 ounces	10 p. m.; 1, 4	720 cc.	1,440
Lactose, 15 Gm		120 Gm.	480
			2,740

11 a. m.:	Calories
Eggs, 2	160
Toast, 2 slices	160
Butter, 20 Gm	150
Mashed potato, 70 gr	70
Custard, 8 ounces	500
	1,040

5 p. m.:	Calories
Egg, 1	80
Toast, 2 slices	160
Butter, 20 Gm	150
Cereal, 6 tbsps	290
Cream, 4 ounces	240
Applesauce, 1 ounce	30
Tea	
Cream, 2 ounces	120
Lactose, 20 Gm	80
	1,150

	Calories
7 a. m.:	
Eggs, 1	80
Toast, 2 slices	160
Butter, 20 Gm	150
Coffee	
Cream, 3 ounces	180
Lactose, 20 Gm	80
	650

The diet for this day furnishes 5,570 calories. The menu for the hospital "dinner" calls for chicken, and therefore should not be employed until convalescence is well advanced.

	Hours	Total	Calories
Milk, 5 ounces	9 a. m.; 11, 1, 7	1,050 cc.	700
Cream, 3 ounces	10 p. m.; 1, 4	630 cc.	1,260
Lactose, 15 Gm		105 Gm.	420
			2,380

	Calories
11 a. m.:	
Eggs, 2	160
Mashed potato, 80 Gm	80
Custard, 8 ounces	500
Creamed chicken, 1 ounce	50
Toast, 2 slices	160
Butter, 20 Gm	150
	1,100

	Calories
3 p. m.:	
Lemonade (lactose, 120 Gm.)	480
7 p. m.:	
Egg, 1	80
Cereal, 5 tablespoonfuls	250
Cream, 2 ounces	120
Toast, 2 slices	160
Butter, 20 Gm	150
Coffee	
Cream, 2 ounces	120
Lactose, 20 Gm	80
	960

These recipes were arranged with the double purpose of adding variety to the patient's dietary, and rendering the milk sugar more palatable, thus making it possible to increase the quantity administered.

RECIPES ARRANGED BY MISS EDNA CUTLER, FORMERLY DIETITIAN TO BELLEVUE HOSPITAL

Cocoa with Milk:

	Calories
1 rounding teaspoonful of cocoa	50
2 ounces of milk sugar	240
4 ounces of milk	80
2 ounces of cream	120
	490

Mix the sugar and cocoa; cook in the milk until dissolved. Serve with the cream.

Cocoa:

1 heaping teaspoonful of cocoa	50
2 ounces of milk sugar	240
½ cup of water	
3 ounces of cream	180
	470

Mix the cocoa and sugar, add the water, and boil. Then add the cream, or use less cream and serve with whipped cream.

Coffee:

1½ ounces of milk sugar	180
4 to 5 ounces of strong coffee	
2 ounces of cream	120
	300

Plain Junket or Rennet Custard:

25 Gm. (1 ounce) of milk sugar	100
5 ounces of milk	100
¼ junket tablet	
1 ounce of cold water	
Few drops of vanilla	
	200

See directions for cocoa junket.

Cocoa Junket:

1 teaspoonful of cocoa	50
25 Gm. of milk sugar	100
5 ounces of milk	100
¼ junket tablet dissolved in 1 ounce of cold water	
	250

Mix the cocoa and sugar, add the milk, and heat *lukewarm*, stirring constantly; add the dissolved junket, stir thoroughly, and leave in a cool place to set.

Soft Custard:

1 cup of milk (8 ounces)	160
1 egg	80
2 ounces of milk sugar	240
Speck of salt	
2 to 3 drops of vanilla or	
Caramel made of 3 tablespoonfuls of granulated sugar	20(?)
	500

Beat the egg slightly, add the sugar, salt and hot milk slowly. Cook in a double boiler, stirring constantly, until it thickens a little (if cooked too long, the custard will curdle, but may become smooth again if set in a dish of cold water and beaten at once). Flavor and cool.

To make caramel: Put the sugar in a pan directly over heat and burn until a very dark brown. Dissolve in hot water or milk.

Baked Custard:	Calories
1½ ounces of milk sugar	160
6 ounces of milk	120
1 egg	80
Nutmeg or vanilla	
Speck of salt	
	360

Beat the egg slightly. Warm the sugar and milk, stirring constantly, add to the egg, strain into a custard cup and flavor. Bake in a pan of water in a moderate oven until a knife when cut into it will come out clean (30 minutes to 1 hour).

Bread Pudding:	
1½ ounces of milk sugar	180
6 ounces of milk	120
1 egg	80
1 slice of bread (⅜ inch thick) *	60
½ ounce of butter	120
	560

Spread the bread with butter and cut into squares. Beat the egg slightly; heat the milk and sugar, stirring constantly; mix with the egg and pour over the bread. Grate nutmeg over the top, and bake the same as the custard.

Vanilla Ice-cream:	
4 ounces of cream	240
2 ounces of milk	40
2 ounces of milk sugar	240
Speck of salt	
Few drops of vanilla	
	520

Mix the cream, milk, and sugar, and heat, stirring constantly, until the sugar is dissolved. Then flavor, cool, and freeze.

Lemonade:	
4 ounces of milk sugar	480
7 ounces of cold water	
2 tablespoonfuls of lemon juice (or to taste)	

Boil the sugar and water for two minutes, add lemon juice to taste, strain and cool.

TUBERCULOSIS

Metabolism.—The metabolism of tuberculosis does not show the marked increase in rate seen in typhoid fever; McCann and Barr[20] found that there was not as much increase as in other fevers. Incipient cases probably show no increase, but temperatures above 39° C. (102.2° F.) are sometimes accompanied by a metabolic rate which is from 20 to 30 per cent above the normal. This failure of tuberculosis to show the usual metabolic increase has been attributed to the fact that in this disease high fever is often seen with relatively little toxic disturbance. On the other hand, profound toxic disturbance even though accompanied by little or no fever will produce an increased rate; Graefe[21] found an increase in metabolism of from 20 to 36 per cent in the majority of patients with severe nonfebrile tuberculosis.

Protein destruction is not as great in tuberculosis as in typhoid fever. McCann[22] found that the nitrogen excretion in this disease is less than in other infections, that it is not difficult to establish nitrogen equilibrium on a low protein intake, and that such an equilibrium can be maintained with a daily excretion of only 2.5 to 9.4 Gm. of nitrogen (15 to 60 Gm. of protein). In tuberculosis protein exerts the same specific dynamic action that is seen in the normal person.

In discussing the influence of the various foodstuffs in this disease, the author just quoted states that carbohydrate and protein increase materially the volume of respiration as well as the total metabolism; he found that 100 Gm. of cane sugar calls for such an increase in carbon dioxide production that pulmonary ventilation is increased 60 per cent. Fat, however, does not possess this disadvantage, for the administration of 140 Gm. of fat with 1,302 calories had but little specific dynamic action, and increased pulmonary ventilation only 12 per cent. This author suggests that these facts support the older clinicians in the giving of large quantities of fat in tuberculosis.

From these facts it is justifiable to conclude, then, that for proper maintenance the tuberculous patient does not as a rule require as much increase in food as is demanded in other fevers, and that a proportionately large quantity of fat in the diet is of advantage.

Before proceeding to a discussion of diet in tuberculosis, some reference should be made to other useful therapeutic measures; otherwise dietary regulation will be of little avail. Every physician today knows that rest, fresh air and food are the three factors which count most in promoting recovery from tuberculosis. The value of rest is properly appreciated, but undue emphasis is often laid on fresh air and climate, and the patient is sent away chiefly to obtain the benefits of these. This is often justifiable, especially when the physician or the family feel that they are unable to carry out treatment at home; but occasionally it is a mistake, and the patient had much better remain at home where he can be comfortable and happy. I say this because to the three curative factors just enumerated there should be added a fourth, contentment, and this cannot always be obtained amid strange surroundings. This psychic side to the treatment of tuberculosis is too often neglected. The patient should as far as possible be placed in congenial surroundings and should be given all legitimate encouragement. Contentment is of such importance that it is even better, for example, to permit the tuberculous wage earner to remain in a slightly unfavorable occupation in which he is contented and successful rather than take up some new more wholesome work, which he understands but poorly and in which he will have difficulty earning a living. If the importance of rest, good air and contentment are fully understood, and if these factors are utilized to their fullest extent, then we can expect much more from diet.

The Diet in Tuberculosis.—Tuberculosis is a debilitating disease, in which emaciation is a salient feature, and the effort should be to prevent this by appropriate diet. So deeply have the medical profession and the laity become impressed by the ominous nature of this sign, that the effort is commonly made to induce the patient to gain weight at all cost; the more weight the better. Forced feeding is often the rule and marked gain in weight even to the point of obesity is looked on as a most satisfactory sign. This is an error. Gain in weight follows improvement, but improvement does not necessarily follow forced gain in weight. It is an obvious error always to regard obesity as an evidence of robust health. We are coming more and more to the realization that, other things being equal, in health or disease the lean person is the more robust, and that he has the greater life expectancy. Scrutiny of patients who have recovered from tuberculosis and who have long remained well is proof of the truth of this; they are seldom fat people. The situation here is not unlike that in diabetes. Increased weight even to the point of moderate obesity in diabetes is often regarded by the patient and relatives as evidence of improvement and of a satisfactory state of health; in truth, it is very dangerous, for these patients go to pieces easily, sometimes with dramatic suddenness. Likewise in tuberculosis marked over-weight may be deceptive. This is not an argument for the undernutrition which has been found desirable in diabetes, but is merely a protest against the suralimentation which in tuberculosis was the practice of the past. The tuberculous patient should be well nourished and should maintain his body weight at a figure which is equal to or perhaps a few pounds above the calculated ideal, but he should not become fat.

In this connection a warning should perhaps be given against the excessive use of milk and eggs. These articles are excellent and should always be used in tuberculosis, but they should not be taken to the exclusion of other good foods. Mental inertia sometimes prompts the physician merely to tell the patient to "take large quantities of milk and eggs;" such a diet requires no effort in the planning, but it is not fair to the patient. This statement does not apply, however, in those instances in which the patient is very poor and is so situated that he cannot secure good, well prepared food of the right kind, for in these cases milk and eggs sometimes provide the only available good food. As a rule, the diet should be well balanced and not limited to any one or two articles.

The food of the tuberculous patient should possess the following characteristics: 1. It should be ample—slightly more than the patient's calculated caloric requirement. In ordinary tuberculosis of moderate grade with little or no fever the patient requires about the same food, in slightly increased amounts as in health. A man weighing 70 kilograms who is up and about but is doing no work will need about 40 to 45 calories per kilogram of body weight, say from 2,800 to 3,000 calories, in which should be included from 100 to 110 Gm. of protein. If he is working at some light occupation, this should be increased to say, 3,200 or 3,300 calories, and the protein to 125 Gm. If he is doing actual manual labor, the diet should provide about 3,600 calories. For women these estimates may be decreased about 8 or 10 per cent. The younger the patient, the greater the proportionate caloric need and protein requirement. These figures are merely tentative, for experience has demonstrated the existence of great differences in the food requirement of individual patients. The physician should use his clinical judgment and be guided somewhat by the patient's appearance, vigor and sense of well-being.

2. The ration should be well balanced and should not be lacking in vitamins, minerals or roughage. The need for a well balanced diet is even more imperative for the tuberculous patient than for the person in health. Protein should be permitted in liberal though not in excessive amounts, say from 1.5 to 1.75 Gm. per kilogram of body weight. The belief of the older clinicians in the value of a generous fat diet in tuberculosis is borne out by the observations of McCann that fat, in contra-distinction to carbohydrate, increases but little the respiratory volume. Carbohydrate, however, should furnish at least 50 per cent of the energy of the diet. To insure an abundance of vitamins and minerals, the patient should be given green vegetables, fruit juices and tomatoes, as well as milk.

3. The food should be simple, easily digested and well prepared. Because of lack of appetite, it is often difficult to induce the patient to eat what is prescribed for him; therefore, it should be served him as far as possible in an attractive manner. It should not be monotonous. Good cooking is an art; it is unfortunate that in this country among our poorer people it is so little understood. It is in the cooking of meat and the preparation of vegetables that the fault most often lies. In such a situation it is encumbent on the physician to give instructions or have them given to some member of the family as to the rudiments of the preparation and cooking of food. The difficulty here is that people are only too often satisfied with their own thoroughly inadequate methods of cooking and do not want to improve. Real missionary work must be done.

The arrangement of the tray when the patient is in bed or the manner in which the food is served at the table is of importance. Happy surroundings and pleasant conversation at the table count. If the patient is in bed, he should not be permitted regularly to order his own food or be told what he is to receive.

4. The menu should be planned to meet individual needs and tastes. A single type of diet which every patient must take is bad. The physician must be familiar with the patient's habits, tastes and economic status, for in the arrangement of the diet these factors must be taken into consideration.

5. Good discipline is advisable. The physician in his dietary instructions must be explicit, and he should insist that his directions be followed, for laxity and too much latitude is likely to lead in the end to complete disregard of all directions. Preconceived notions of the patient or his friends, if they are unsound, should be disregarded; dogmatism in dealing with patients is not a bad thing.

Digestive Disturbances.—These disturbances usually demand a rearrangement of the diet. They are sometimes produced from an attempt to overfeed the emaciated febrile patient whose powers of assimilation have been materially impaired. In such cases it is much better to give a reasonable amount of food which the patient can properly assimilate than to give him more than he can take care of. Diarrhea sometimes follows an excessive intake of fat. Too much protein will sometimes cause the same disturbance. An excess of carbohydrate may produce flatulence and abdominal discomfort. Constipation can be corrected by increasing the roughage of the diet and by giving agar. Anorexia is another great obstacle. Care of the mouth, variety in the choice of food, and encouragement are the measures which help to overcome this.

MENUS FOR PATIENTS WITH TUBERCULOSIS

I.

Breakfast:
- ½ glass orange juice
- Average helping cooked cereal
- Poached egg, 3 crisp slices bacon, 2 slices toast
- 1 tbsp. butter, 2 tbsp. sugar
- 1 cup coffee, ½ cup thin cream

Dinner:
- 2 medium sized slices roast beef with gravy
- 2 heaping tbsp. mashed potatoes
- 2 h. tbsp. creamed peas
- A. h. lettuce and tomato salad with ½ tbsp. mayonnaise
- 1 corn muffin, 1 tbsp. butter
- Apple tapioca pudding, 2 h. tbsp. with 2 tbsp. cream
- 1 glass milk

Supper:
- 1 cup cream of celery soup with 2 crackers
- Cheese souffle made with 1 egg, ⅛ cup cheese, ⅓ cup milk, 1 tbsp. flour, ⅔ tbsp. butter
- 1 m. s. baked white potato
- 1 slice bread, 1 tbsp. butter
- A. h. pear sauce (canned) eaten with 5½ tbsp. cottage cheese
- 1 glass milk

	Protein	Calories
Total	123	3,275

II.

Breakfast:
- A. h. cantaloupe, strawberries or 2 tbsp. stewed fruit
- 3 tbsp. grapenuts, ½ cup thin cream
- A. h. broiled (pan) medium fat steak
- 2 graham muffins, 1 tbsp. butter
- 1 cup coffee
- 1 tbsp. honey

Dinner:
- A. h. roast chicken
- 4 h. tbsp. steamed rice with gravy
- 4 h. tbsp. spinach with ½ hard boiled egg
- 1 m. s. stuffed (with celery, 5 chopped pecans, and 1 tbsp. mayonnaise) tomato salad
- 1 slice bread (whole wheat), 1 tbsp. butter
- 2 h. tbsp. vanilla ice cream
- 1 glass milk

Supper:
- 1 cup pea soup with 2 tbsp. toasted croutons
- 2 egg omelets, 1 tsp. butter
- A. h. hominy grits with 1 tsp. butter
- Plain lettuce salad with French dressing
- 1 m. s. baked apple with 1 tbsp. whipped cream
- 2 a. s. slices toast with 1 tbsp. butter
- 1 glass milk

	Protein	Calories
Approximate total	123	3,344

III.

BREAKFAST:

1 m. s. baked apple with 4 tbsp. thin cream
A. h. (1 cup) cooked oatmeal
1 scrambled egg with 3 slices bacon
2 whole wheat muffins, 1 tbsp. syrup or honey
Coffee, 1 tbsp. sugar

DINNER:

A. h. roast lamb with mint sauce
2 h. tbsp. creamed potatoes
1 large stuffed pepper (bread crumbs and mushrooms)
1 large apple celery and nut salad
2 slices whole wheat bread, 1 tbsp. butter
1 large cup custard (1 egg, 1 cup milk, 2 tbsp. sugar)
1 glass milk

SUPPER:

Oyster stew (6 oysters, 1 cup milk, 1 tbsp. butter) 2 crackers
A. h. (½ cup) rice with cheese and tomatoes
Buttered asparagus on toast (5 stalks, 1 tsp. butter, 1 medium slice toast)
Small fruit salad, 1 cracker
Small glass buttermilk

	Protein	Calories
Approximate total	101	3,300

IV.

BREAKFAST:

½ glass orange juice
A. h. Farina
6 panned oysters on toast with 3 strips bacon
1 graham muffin
1 cup coffee, ½ cup thin cream, 1 tbsp. sugar

DINNER:

A. h. roast beef, medium fat, with mushroom sauce
M. s. baked potato with 1 tsp. butter
1 stuffed baked tomato
Small serving cold slaw
2 corn muffins, 1 tbsp. butter
A. h. rice pudding with 1 tbsp. whipped cream
1 glass milk

SUPPER:

Creamed chicken (½ cup) on toast
Small serving grilled sweet potato
A. h. tomato stewed
Chopped egg salad (1 egg, 1 tbsp. mayonnaise)
1 slice bread, 1 tbsp. butter
A. h. (⅔ cup) snow pudding
1 glass milk

	Protein	Calories
Approximate total	105	3,060

V.

BREAKFAST:
A. h. stewed fruit
5 tbsp. corn flakes with ½ gl. milk
Soft boiled egg, 4 thin slices dried beef "frizzled" on hot buttered pan
2 tsp. butter
2 hot muffins or biscuit with 1 tbsp. butter
1 tbsp. honey
1 cup coffee

DINNER:
2 lamb chops with fat
1 tbsp. mashed potatoes
3 h. tbsp. green peas
Carrot salad—3 h. tbsp. carrots, 1 tbsp. mayonnaise, a bit of onion
1 slice bread
1 tbsp. butter
A. h. lemon Jello with 1 tbsp. whipped cream
1 glass milk

SUPPER:
1 egg soufflé
Baked stuffed tomato
Vegetable salad with 1 tbsp. mayonnaise and chopped celery on lettuce
2 a. s. slices toast with 1 tbsp. butter
Baked banana with 1 tsp. sugar and lemon juice
1 glass milk

	Protein	Calories
Approximate total........	118	3,200

VI.

BREAKFAST:
Fruit
Cereal with thin cream
A. h. broiled fish or 1 egg
2 crisp rolls with 1 tbsp. butter
Coffee

DINNER:
A. h. broiled steak with mushroom sauce
2 h. tbsp. rice or potatoes
A. h. scalloped onions
Asparagus salad (5 stalks and 1 tbsp. mayonnaise) on lettuce
1 corn muffin with 1 tbsp. butter
Boiled custard, ⅔ cup
1 glass milk

SUPPER:
Creamed oysters (6 on 1 slice toast)
A. h. hominy grits with 1 tsp. butter
A. h. spinach
M. s. stuffed (with celery and 1 tbsp. mayonnaise) tomato salad
1 muffin and 1 tbsp. butter
1 glass milk

	Protein	Calories
Approximate total........	113	3,000

VII.

Breakfast:

½ glass orange juice
A. h. oatmeal, ½ cup thin cream
1 egg en casserole with 3 slices bacon
2 bran muffins, 1 tbsp. butter
Coffee, 1 tbsp. sugar

Dinner:

A. h. broiled fish or meat
M. baked potato, 1 tsp. butter
A. h. greens
Pineapple, cheese (1⅛ cube), nut (6 pecans) salad with 1 tbsp. mayonnaise
A. h. (1 cup) Spanish cream
2 corn muffins, 1 tbsp. butter
1 glass milk

Supper:

½ small broiled chicken, ½ tbsp. butter
2 h. tbsp. rice with 1 tsp. butter
2 h. tbsp. creamed corn
Stuffed prune salad (4 large prunes, 4 nuts, 1 tbsp. mayonnaise), 2 crackers
1 graham or whole wheat muffin, ½ tbsp. butter
1 small baked custard
1 glass milk

	Protein	Calories
Approximate total	106	2,900

INEXPENSIVE DIETS FOR PATIENTS WITH TUBERCULOSIS

I.

Breakfast:

1 small baked apple or 2 tbsp. apple sauce cooked
2 tsp. sugar
2 heaping tbsp. or average helping boiled oatmeal with 2 tsp. sugar and ½ cup milk also for coffee
3 slices white meat rolled in meal (chicken)
2 slices bread or 2 biscuit, 1 tbsp. nut butter or oleomargarine
1 cup coffee, 1 tsp. sugar

Dinner:

Potato soup (1 large potato cooked till soft, add 1 cup canned milk diluted, and 1 tsp. bacon fat)
Average helping beef stew with dumplings
A. h. steamed cabbage, 2 muffins, corn
A. h. bread pudding with sauce
1 glass buttermilk, 1 tbsp. nutbutter

Supper:

Large dish (about 3 heaping tbsp. uncooked) hominy grits with 1 tbsp. nutbutter
1 egg scrambled with 2 tbsp. tomatoes
2 slices bread with 1 tbsp. nut butter
2 tbsp. syrup
1 glass milk

Night:

1 glass milk, 1 slice bread with 1 tsp. butter

	Protein	Calories	Cost
Approximate	82	2,800	50¢+

II.

BREAKFAST:

- Large dish oatmeal with 1 tbsp. sugar and ½ cup milk
- Hot toasted cheese sandwich (2 slices bread, 1 slice cheese, about 1 oz.)
- Cup coffee, 2 tsp. sugar, ¼ cup milk

DINNER:

- A. h. soup meat (after boiling for soup) baked
- Large serving spaghetti and tomatoes
- A. h. field peas cooked with white meat, 1 oz.
- 2 corn muffins
- Corn starch pudding (1 cup milk, 1 heaping tbsp. cornstarch, 1 egg, 1 heaping tbsp. sugar), 2 servings
- 1 glass milk

SUPPER:

- A. h. beef soup (rice, macaroni, potato, etc.) served with 4 square crackers
- 1 baked sweet potato with ½ tbsp. oleomargarine
- A. h. baked navy beans
- 1 slice bread, ½ tbsp. oleomargarine, syrup
- 1 glass milk

BEDTIME:

- 1 glass milk and 5 or 6 crackers

	Protein	Calories	Cost
Approximate	96	2,500 to 3,000	49¢

III.

BREAKFAST:

- Small baked apple, 1 tsp. sugar
- Large serving oatmeal, 2 tsp. sugar, and ½ cup milk
- 1 soft boiled egg, 2 slices toast, 1 tbsp. oleomargarine
- 1 cup coffee with 1 tsp. sugar

DINNER:

- Large serving baked macaroni and cheese
- A. h. string beans (canned)
- Scalloped tomatoes (1 cup tomatoes, 1 slice bread, 1 tsp. oleomargarine)
- 2 corn muffins, 1 tbsp. oleomargarine
- Apple tapioca pudding (1 small apple, 1 tbsp. pearl tapioca soaked over night, 1 tsp. butter)
- 1 glass buttermilk

SUPPER:

- 1 cup cream of corn soup with 4 crackers
- Large baked potato with 1 tsp. oleomargarine
- Creamed codfish or fish flakes, ¼ lb.
- 3 tbsp. cream sauce
- 1 slice bread or muffin, 1 tbsp. oleomargarine
- 1 baked banana, 1 tsp. sugar, lemon juice
- 1 glass milk

BEDTIME:

- 1 glass milk, 1 slice bread with 1 tsp. butter
- 1 tbsp. syrup or jelly

	Protein	Calories	Cost
Total approximate	85	2,500 to 3,000	60¢

IV.

Breakfast:
1 small orange
Large helping of hominy grits with ½ tbsp. oleomargarine
½ cup milk, sugar if desired
2 plain muffins with 1 tbsp. oleomargarine
3 slices bacon, 2 tbsp. syrup or jam
1 cup coffee, 2 tbsp. sugar

Dinner:
A. h. beef stew with vegetables
1 medium baked sweet potato with ½ tbsp. oleomargarine
A. h. cabbage slaw
2 corn muffins with 1 tbsp. oleomargarine
A. h. Indian meal pudding
1 glass milk

Supper:
1 scrambled egg
A. h. whole hominy
A. h. creamed lima (dried) beans
2 slices bread, 1 tbsp. oleomargarine
Cup hot cocoa (1 tsp. sugar, 1 tsp. cocoa, 1 cup milk)

Bedtime:
1 glass milk, 1 slice bread with butter and jam or cake

	Protein	Calories	Cost
Approximate....................................	80	2,800 to 3,000	52¢

V.

Breakfast:
2 spoons dried apple sauce
2 slices toast with 6 tbsp. cream sauce
3 strips bacon
1 cup coffee with 2 tsp. sugar and ¼ cup milk

10:00 a. m.: Glass milk

Dinner:
1 large hamburg steak patty (⅓ pound)
2 h. tbsp. mashed potatoes with gravy
A. h. turnip greens
Rice pudding (½ cup boiled rice, ½ egg, ⅔ cup canned milk, 1 tbsp. sugar)
2 corn muffins with 1 tbsp. oleomargarine
1 glass buttermilk

Supper:
A. h. cream of potato soup with 4 crackers
1 egg on toast
2 h. tbsp. hominy grits with 1 tsp. oleomargarine
Few leaves of lettuce salad with vinegar
1 biscuit or 1 slice bread
1 baked banana

Bedtime:
1 glass milk

	Protein,	Calories,	Cost,
Approximate........................	91	2,800 to 3,500	53¢

VI.

Breakfast:

- 1 small orange
- Large bowl oatmeal with 1 tbsp. sugar and ½ cup milk
- 1 egg, 2 muffins
- 1 tbsp. oleomargarine, 1 tbsp. syrup
- 1 cup coffee, 2 tsp. sugar

Dinner:

- A. h. beef roast from chuck
- A. h. spaghetti and tomatoes
- A. h. boiled or steamed cabbage
- 2 corn muffins with 1 tbsp. oleomargarine
- Indian meal pudding (1 cup canned milk
  1 heaping tbsp. meal
  2 tbsp. molasses
  1 tsp. butter
  1 tsp. sugar)
- 1 glass milk

Supper:

- A. h. cream of corn soup with crackers
- A. h. field peas with 3 strips bacon
- 2 slices bread, 1 tbsp. oleomargarine
- 2 tbsp. syrup or jelly
- 1 glass milk

	Protein	Calories	Cost
Approximate....................................	87	2,500 to 2,900	55¢

VII.

Breakfast:

- Small baked apple
- A. h. oatmeal with 2 tsp. sugar and ½ cup milk
- 3 slices white meat rolled in meal (Tenn. chicken)
- 2 bread or biscuits, 1 tbsp. oleomargarine
- 1 cup coffee, 2 tsp. sugar

10:00: 1 glass milk

Dinner:

- A. h. beef stew with potatoes
- A. h. boiled kraut
- A. h. of stewed tomatoes
- 2 bread or corn muffins with 1 tbsp. oleomargarine
- Bread pudding (½ cup crumbs
  ½ cup canned milk
  ¼ cup sugar
  1 spoon raisins
  Serve with ¼ cup milk
- 1 glass milk

Supper:

- 1 egg scrambled with ½ cup cooked brains
- A. h. hot grits with 1 tsp. butter
- 2 plain muffins with 1 tbsp. oleomargarine
- 1 baked banana with 1 tsp. sugar, lemon juice
- 1 glass milk

Bedtime:

1 glass milk, 1 slice bread, 1 tsp. butter, jam

	Protein	Calories	Cost
Approximate	88	2,500 to 3,000	62¢

DIETS FOR TUBERCULOSIS PATIENTS WHO MUST REMAIN IN BED

First Day:

6:00 a. m.: 1 glass orange juice
8:00: 1 egg on toast, 1 glass milk
10:00: ⅔ cup oatmeal with 2 tsp. sugar and ¼ cup thin cream, 2 tbsp. apple sauce
12 Noon Cup custard (1 cup milk, 1 egg, 2 tsp. sugar)
1 cup cream of celery soup, 2 crackers
2:00 p. m.: 6 creamed oysters on toast
4:00: Milk and egg shake, ½ cup apple tapioca
6:00: 1 soft egg, 1 slice toast, 4 stewed figs
8:00: Cream of wheat with ½ tbsp. butter and glass milk

	Protein	Calories
Total average	92	2,600

Second Day:

6:00 a. m.: Glass hot milk
8:00: 1 soft boiled egg, 1 thin toast, 1 tbsp. butter, cup cocoa
2 tbsp. apple sauce
10:00: Boiled custard
12 Noon 1 lamb chop, 1 toast, small baked potato, ½ tbsp. butter
2:00 p. m.: 1 glass milk
4:00: 1 cup cream of corn soup with 4 crackers
6:00: 4 heaping tbsp. hot hominy grits with 1 tbsp. butter
Average serving apple snow with 2 tbsp. whipped cream
8:00: Glass milk, half thin cream
½ cup cornstarch pudding

	Protein	Calories
Total average	82	2,611

Third Day:

6:00 a. m.: 1 glass orange juice
8:00: 1 cup cooked oatmeal with 1 tbsp. sugar and ½ cup thin cream
10:00: 1 coddled egg, 1 toast, 1 tbsp. butter, 1 tbsp. marmalade
12 Noon Milk and egg shake with 1 tsp. sugar
2:00 p. m.: 1 4 inch scraped beef patty, small baked potato with ½ tbsp. butter
4:00: A. helping rice custard, 1 glass milk
6:00: Cream of oyster soup (6 oysters, 1 cup milk, 1 tbsp. flavor, 1 tbsp. butter) 4 crackers
8:00: 1 toast, 1 medium sized baked apple with 2 h. tbsp. whipped cream
½ glass milk

	Protein	Calories
Total average	92	2,720

FOURTH DAY:

6:00 a. m.: 1 glass hot milk
8:00: 1 cream toast with 2 slices crisp bacon
1 cup cocoa, soft boiled egg
10:00: 2 heaping tbsp. Farina with 1 tbsp. sugar, and 4 tbsp. cream
2 heaping tbsp. apple sauce, 1 glass milk
12 Noon 2 heaping tbsp. creamed chicken on toast
3 h. tbsp. tapioca pudding, 1 tbsp. whipped cream
2:00 p. m.: 1 glass orange juice
4:00: Milk and egg shake with 1 heaping tsp. sugar
6:00: Egg on toast
Cup cocoa
8:00: 3 heaping tbsp. Floating Island, 1 glass milk

	Protein	Calories
Total average	87	2,800

FIFTH DAY:

6:00 a. m.: 1 glass orange juice
8:00: Average helping Farina, 1 tbsp. sugar, 4 tbsp. cream
6 panned oysters on toast, 1 tbsp. butter
10:00: 1 glass milk, dish of prunes (4 large)
12 Noon ½ cup cream of pea soup with croutons (1 slice bread)
2:00 p. m.: 1 small serving tenderloin steak, 1 spoon mashed or creamed potatoes
4:00: 2 heaping tbsp. chocolate custard, 1 tbsp. whipped cream
6:00: Soft boiled egg, ½ slice toast, 1 glass milk
8:00: 1 glass orange juice, 2 crackers

	Protein	Calories
Total average	87	2,000

SIXTH DAY:

6:00 a. m.: Cup hot milk, 2 crackers
8:00: 2 heaping tbsp. oatmeal, 2 tsp. sugar, 4 tbsp. cream, 1 cup cocoa
10:00: Coddled egg, 3 strips crisp bacon
1 small toast, 1 tsp. butter
12 Noon: 6 creamed oysters on toast, glass orange juice
2:00 p. m.: Glass milk, 1 slice toast, ½ tbsp. butter, 1 tbsp. apple sauce
4:00: Milk and egg shake
6:00: Average helping cream of wheat with ½ tbsp. butter
1 glass milk, ½ cream
8:00: 1 medium baked apple; ½ glass milk

	Protein	Calories
Total average	88	2,672

SEVENTH DAY:

6:00 a. m.: 1 glass orange juice
8:00: Soft boiled egg, ½ toast, 1 cup cocoa, ½ tbsp. butter
10:00: A. helping cooked cereal, 1 tbsp. sugar, 4 tbsp. cream
12 Noon: 1 lamb chop, 1 medium baked potato
1 glass milk, 1 tbsp. butter
2:00 p. m.: 1 baked apple with 1 tbsp. whipped cream
4:00: Milk and egg shake
6:00: 1 cup cream of corn soup, 4 crackers
1 baked custard
8:00: 1 glass milk, 1 slice toast, 1 tsp. butter

	Protein	Calories
Total average	92	2,739

LIQUID AND SEMILIQUID TUBERCULOSIS DIETS. (FEEDING EVERY 2 HOURS)

First Day:
6:00 a. m.: ½ glass orange juice
8:00: 3 heaping tbsp. strained oatmeal with 2 tsp. sugar
2 tbsp. cream, 1 cup cocoa
10:00: 1 glass milk, ⅔ cup boiled custard
12 Noon: Milk toast (1 slice toast, 1 cup hot milk, 1 tsp. butter)
Prune souffle
2:00 p. m.: Milk and egg shake with 2 tsp. sugar, flavoring
4:00: Cream of oyster soup (3 oysters, 1 tsp. butter, 1 cup milk) 2 crackers
6:00: One soft boiled egg, small slice toast, 1 tsp. butter, 1 glass milk
8:00: 1 glass milk, 1 medium baked apple with 1 tbsp. whipped cream
Average calories.. 2,375

Second Day:
6:00 a. m.: 2 tbsp. prune pulp with 2 tbsp. cream
8:00: 1 soft boiled egg, 1 medium slice toast, 1 glass milk
10:00: ¾ cup well cooked Farina with 1 tbsp. sugar and ½ cup thin cream
12 Noon: 1 slice creamed toast with 1 egg yolk
Cup cocoa
2:00 p.: Milk and egg shake
4:00: 1 cup cream of tomato soup with 1 slice toast, 1 tsp. butter
6:00: 1 egg omelet, toast, 1 tsp. butter
1 cup cocoa, 4 tbsp. Junket
8:00: 1 glass milk, 1 tbsp. whipped cream, 2 tbsp. rice custard
Average calories.. 2,500

Third Day:
6:00 a. m.: 1 glass orange juice
8:00: 1 cup boiled oatmeal with 1 tbsp. prune pulp and 1 tbsp. sugar
4 tbsp. cream
10:00: Poached egg on toast, 1 glass milk
12 Noon: Cream of tomato soup (1 cup) with croutons (1 toast)
2:00 p. m.: Milk and egg shake
4:00: 1 cup soft custard
6:00: 1 slice toast, 1 tsp. butter
6:00: 4 heaping tbsp. Farina with ½ tbsp. butter and 1 glass milk
8:00: 2 tbsp. apple sauce, 1 slice toast, 1 tsp. butter
1 glass milk
Average calories.. 2,278

PNEUMONIA

Metabolism.—The metabolism of pneumonia is increased from 20 to 50 per cent above the normal basal level, and in severe cases may go even higher. As in other infectious diseases, the respiratory quotient during the febrile period is low, but rises when convalescence is established.

Pneumonia is distinguished by certain peculiarities of nitrogen and chloride metabolism. There is a moderate increase of nonprotein nitrogen in the blood, which at times is so pronounced as to suggest a mild degree of real insufficiency. Immediately after the crisis there is a sudden increase in nitrogen output; this probably represents a breaking down of the large amount of protein exudate held in the lung and the excretion of the resulting disintegration products. The chloride content of the blood in pneumonia is low, frequently below the threshold value. The cause of this is not clear. Large quantities of chlorides are retained in the lung exudate, but this is not believed to be sufficient to account in full for the marked chloride retention. The lessened chloride content of the urine can be explained on the assumption that the body holds tenaciously to its minimal chloride supply, and that when the blood chlorides fall so low as to approach the threshold value, very little if any are permitted to pass off in the urine.

There are other as yet poorly understood disturbances of mineral metabolism in pneumonia. There is always a mild degree of acidosis.

Pneumonia is a general disease the salient manifestations of which are in the lungs. The extent and location of lung involvement, however, requires comparatively little attention. The heart presents the chief hazard, and the condition of the circulation requires constant thought. It is a relatively short, often stormy, illness, in which the patient's strength and ability to endure his brief but severe intoxication will determine the outcome. I speak of this in order to emphasize the fact that the chief object in arranging the diet of the patient with pneumonia should not be to give him an abundance of nourishment, but rather to require of him the least possible exertion in the taking of food. There can easily be too much meddling in pneumonia. I do not refer solely to the giving of drugs which are merely useless, but more particularly to the giving of the many nauseous cough mixtures and other medicines which upset the stomach and interfere with proper nutrition. It is a grievous error for the physician who treats patients with pneumonia in the home to feel that he is called on to give large quantities of medicine. Perhaps it is not out of place here to speak of the harm of turning the patient over in order to examine the entire lung area on each visit; having once made the diagnosis, the physician should thereafter disturb the patient as little as possible.

The Diet in Pneumonia.—Because this is a brief illness, the outcome of which is usually determined within a few days, the actual amount of nourishment which the patient receives is of comparatively little importance. He needs liquids, and for this reason should be given sufficient quantities of water and liquid foods. Solid food is unnecessary. Small quantities of food at frequent intervals given with the least possible disturbance to the patient should be the rule. While a certain amount of firmness is advisable, the patient's preferences should be given consideration, and foods which he finds distasteful should not be insisted on.

Approximately 2,000 calories daily is ample for the adult who has pneumonia; in some cases it is best not to give this even amount. This should include about from 50 to 60 Gm. of protein. Milk is eminently suitable; about 1 quart daily should be given. It is best taken straight, or it may be peptonized or diluted with lime water. For variety's sake some of the milk may be flavored with coffee or cocoa; or buttermilk or clabber may be given. Ice cream, malted milk and cup custards are also suitable. Two or perhaps three eggs may be given daily. Broths, thin vegetable purees, liquid cooked cereals, such as strained oatmeal or farina, and fruit juices are all valuable. The food should be given at regular intervals, usually every two or three hours. For the patient who is accustomed to drink coffee, one or two cups daily is advisable, and if he is unable to take food by mouth, it is advisable, at times to give black coffee by rectum. As convalescence begins, semisolid and solid food may be permitted. It is best to proceed with reasonable deliberation in increasing the food of the convalescent; he should not be permitted suddenly to take a large unlimited amount of food. The distressing abdominal distention which sometimes accompanies pneumonia has little or nothing to do with the diet. It probably represents a toxic paralysis of the bowel and cannot be combated by mere dietary regulation.

Alcohol has always been regarded as a valuable food as well as stimulant in pneumonia; some patients are able to take relatively large quantities without evidence of intoxication. The sickroom should not be regarded as a reformatory, and the pneumonia patient who is accustomed to the use of alcohol should continue to take it, say ½ ounce of whisky every four hours. Alcohol is valuable in the treatment of pneumonia of elderly people, and its administration is imperative in the case of the person who has been accustomed to its use, but it need not be given to the youthful patient who is unaccustomed to it.

OTHER INFECTIOUS DISEASES

The diets advised in the three diseases just discussed can, with appropriate adjustment, be used in all other infections. The diet in typhoid fever is suitable for any acute but debilitating long continued infection, that in tuberculosis for the chronic long continued disease, and that in pneumonia for the acute stormy disease of short duration. With this understanding, the diets of other infectious diseases require little more than passing mention.

Scarlet Fever.—In scarlet fever it is advisable to give at first only milk and fruit juices; then after a time cereals may be added. The milk may be modified in any suitable manner: peptonized, diluted with lime water or with barley water, or flavored with cocoa. Buttermilk or kumiss may also be given. Ice cream and water ices may be permitted in small quantities. The great frequency with which nephritis occurs in this disease demands caution in the use of protein. During the acute illness, it is best to give little protein except that contained in milk. Broths and meat soups should be avoided until the patient has entirely recovered. As convalescence sets in, or earlier when the illness is not particularly severe, cereals with cream, toast with orange marmalade or other preserves, and cooked fruits may be given. Later, fresh fruits and the simpler puddings, such as rice pudding, tapioca pudding, or cup custard may be allowed. After about three weeks, soft boiled eggs and oysters are suitable; then a little meat with the simpler vegetables. Alcohol should not be given.

Measles.—For patients with measles the diet just advised in scarlet fever is entirely suitable. It is permissible to add, however, soft boiled or poached eggs and other protein foods which are not allowed in scarlet fever.

Mumps.—Mumps demand no dietary precautions other than the comfort of the patient and the height of the fever would suggest. Because of the local disturbance, the food should be largely liquid. Highly seasoned foods and acids increase the patient's discomfort, and therefore should be avoided.

Whooping Cough.—Because this is often a long drawn out disease, close attention to the diet is demanded. Children with this disease are likely to become greatly debilitated and even emaciated because they have been improperly nourished. Loss of food from vomiting during the paroxysm may become a serious matter, and even independently of the paroxysm it may become a frequent occurrence. The food should be simple and easily digested, and should be taken at regular intervals.

Milk should be the chief item of the diet and for very young children the only food. Strained cereals, custards, gruels, broths with toast or barley and home made ice-cream are useful. Eggs, soft boiled or poached or in the form of custards, may be given. When the condition of the stomach permits, chicken, tender roast beef and other meats should be allowed children of 4 years or more. Alcohol diluted and in small quantities such as is found in panopepton and liquid peptonoids has been advised. Whisky well diluted may with benefit be given those patients in whom the vomiting is especially serious. The secret of feeding the child with whooping cough lies in the exercise of patience and persistence; he should be given a sufficient amount of any simple, easily digested foods which will not increase his digestive disturbances.

Diphtheria.—In diphtheria the diet and the precautions suggested for pneumonia are suitable. In the case of nursing infants, it has been suggested that if the mother is susceptible, her milk should be drawn with a breast pump and fed from a bottle. When there is difficulty in swallowing, liquids or semisolid food only should be given, in small quantities and at regularly frequent intervals. Milk, ice-cream, thin gruels and malted milk are of value. This disease today is of such short duration that lack of sufficient food during the height of the attack is not of serious moment. It is important, however, that enough water be given; this may be by rectum, or a nasal tube may be passed and both nourishment and water be given in this manner.

Influenza.—During the ascending and the acute stage in influenza the diet advised above for pneumonia is suitable; later as convalescence is established, recourse should be had to the high calorie diet of typhoid fever. Good nutrition during convalescence will sometimes prevent the weakness, lassitude, functional neuroses and other troubles which sometimes follow influenza.

Malaria.—Malaria demands merely simple, well prepared food. Unfortunately, the patient who is so located that he is exposed to frequent malarial infection is often unable to secure well prepared food. I am sure nutritional failure as well as the malarial organism is responsible for the debilitated, undernourished malarial patients frequently seen in the country and in the small towns. What has been said of the diet in tuberculosis applies with equal force here. During the chill and febrile paroxysm of tertian or quartan malaria no food is demanded. After the paroxysm and in chronic malaria of the aestivo-autumal type an abundance of good food is demanded. If the physician believes that the patient can not secure well prepared, appetizing food, he should recommend large quantities of milk and eggs, say 2 quarts of milk and 4 or 5 eggs daily.

Typhus Fever.—This disease is rare in this country except in the mild form called Brill's disease. The type of diet recommended for typhoid fever is entirely suitable. Its high caloric value is useful in preventing the debility which sometimes follows, but when this debility extends to the digestive system it is sometimes necessary to reduce the total amount of food. As a rule, however, the dietaries given above for typhoid fever can with advantage be taken by patients with typhus fever.

In its severer form there are two features of the disease which may make the feeding of the patient especially difficult; vomiting and delirium. When the vomiting is persistent, feeding by mouth must be suspended, and fluids, with such nourishment as is possible, should be given by rectum. When the patient cannot be induced to swallow because of continued delirium, the nasal or the stomach tube must sometimes be used. Improvement usually begins at about the end of the second week, after which feeding is less difficult. To patients who are accustomed to its use, alcohol as whisky and water or as light wine should be given.

Septic Infections.—In the various septic infections the acuteness or the chronicity of the process should to some extent govern the nature of the diet. In puerperal sepsis of extreme grade, for instance, the type of diet recommended for pneumonia is best; in the more chronic infections with moderate elevation of temperature, the diet suggested for pulmonary tuberculosis is suitable. The typhoid fever diet is also suitable in chronic septic infections, except that an excessively high caloric intake is not necessary.

Many septic infections, such as that of endocarditis, are essentially chronic and may continue for years; therefore the diet is of great importance. During the acute exacerbation of a chronic process, when the intoxication is increased and the temperature elevated, the food should be liquid or semisolid. Milk, cereals with cream, soft boiled eggs, custards, toast with orange marmalade or other preserves, broths thickened with rice, ice-cream, tapioca or rice pudding and similar articles are suitable. At other times when the course of the disease is more chronic and when there is less toxemia, solid food may be given, such, for instance, as is advised in chronic pulmonary tuberculosis. For such patients a well balanced diet should be provided, containing from 35 to 40 calories per kilogram of body weight; protein should comprise from 100 to 120 Gm. of this diet, and milk, fruits and green vegetables in amounts sufficient to insure an adequate intake of vitamins and minerals should be included. Lack of appetite, especially as regards meat, may cause difficulty; everything possible should be done to make the food palatable and attractive. Care should be taken to avoid monotony. The taking of a little alcohol in the form of whisky and water or of light wine is often helpful, and in suitable cases should be encouraged.

Meningitis.—In all forms, this condition demands the same feeding methods. The severity of the illness, the frequency of convulsions and the state of the patient's consciousness should determine the nature of the diet and the frequency of feeding. Liquid foods, such as milk, milk and egg, and fruit juices given in small amounts at frequent intervals are usually best. Occasionally it is necessary to pass the nasal tube or the stomach tube. In the more acute stages of a severe meningitis, when the giving of food is especially difficult, it may be necessary for a time to desist from all attempts at feeding; a few days of starvation will do no harm, provided sufficient water is given.

Tetanus.—The great difficulty in the feeding of patients who have tetanus is not in the choice of food but in giving any food at all. At first, before the jaws become locked, a little food in liquid form can be swallowed, but later the taking of anything by mouth becomes extremely difficult. It has been suggested that a little semisolid food be placed inside the buccal surface in the hope that some of it may be washed around the teeth. The only possible way, however, of giving these patients food in appreciable amounts is to pass a nasal tube into the stomach. The nose may be sprayed with a 2 per cent cocaine solution to facilitate the passage of the tube, or a little chloroform may be given. Sometimes the tube may be left in place attached to the cheek with adhesive tape. I have left such a tube in a patient with chronic tetanus for five days, and in this manner kept her well nourished.

Tetanus is as a rule of such short duration that the question of nourishment is seldom a pressing one. The giving of water is of more immediate importance. The nasal tube may be utilized for this purpose, or fluids may be given by the drop method per rectum. For the latter route, either plain tap water or glucose solution may be used.

Yellow Fever.—Thanks to the work of Gorgas and of Carter, this fever bids fair to disappear from the earth; therefore it seems hardly worth while to devote much space to it. The most distressing feature of is vomiting, which makes the taking of food especially difficult. During the first few days when the fever is high, only water and liquid foods should be given; but during the stage of remission which follows, semisolid food may be given unless vomiting begins early, when attempts should not be made to give food by mouth. Liberal quantities of water and glucose solution should be given by rectum in order to prevent dehydration. As the black vomitus subsides and convalescence sets in, semisolid foods may be given.

Smallpox.—The diet in this disease should vary according to the height of the fever and the severity of the intoxication, but there is always one chief rule: it must be liberal in amount during the earlier stages in order to prepare the patient for the debilitating effects of the suppurative stage. To accomplish this a well planned dietary should be specifically ordered in the beginning, and precautions should be taken to see that it is observed. Liberal quantities of water and other fluids at certain definite intervals should also be prescribed. The dietary principles and the menus advised for typhoid fever are applicable to this disease. When the fever is high, liquid and semiliquid foods should be given; as it subsides, both in the interval antecedent to the suppurative stage and in the convalescent period, more liberal diets, such as are found on page 592, should be used.

Asiatic Cholera.—The chief reason for the consideration of food in this disease is not the good it may accomplish but the undoubted harm it will do if injudiciously given. Infected food or drink is the usual source of transmission; and any food given during the illness is likely to be an aggravation.

In the prevention of cholera every effort should be made to avoid contaminated food and water. During epidemics and in countries where the disease is endemic no salads or uncooked fruits or vegetables should be eaten, and all drinking water or milk should be sterilized. Eating and drinking utensils should be washed and rinsed in water which has been boiled. Only ice of unquestioned purity, such as is made from sterilized water, should be used. Precaution should be taken to prevent contamination of food by cooks and other servants whose hands may have become contaminated. Since flies can carry the vibriones, it is important that they should not have access to the food.

Three stages of Asiatic cholera are recognized: (1) the premonitory stage; (2) a stage of evacuation with purging, vomiting, and muscle cramps, and (3) a stage of collapse. The premonitory stage calls for prompt and rigid treatment, the chief object being absolute rest, both general and alimentary. During an epidemic, even small digestive disturbances in those who are apparently healthy necessitate immediate rest in bed, without food. It is proper to give morphine at this stage, but purgatives and intestinal antiseptics are not only useless but harmful. Strong[23] says: "Long experience has demonstrated that it is better not to administer by the mouth anything that is not essential for the patient and that the best results are to be obtained by bringing about as complete a rest of the intestines as possible." During the second and third stages, the copious evacuation of fluids and the resulting collapse dominate the clinical picture. The osmotic flow of fluids in large quantities from the vessels into the intestinal canal, from the tissues into the vessels and from the cells into the tissues results in extreme dehydration. This dehydration with resulting uremia and circulatory failure are the salient features of the disease, and their correction is the chief object of treatment. No food whatever should be given by mouth, except perhaps a little rice or barley water. There is no objection to giving water by mouth; if it is retained it will probably do good, but often it is useless because of vomiting. Cracked ice may be used to allay thirst.

When the pulse becomes thin and thready or disappears, and when the blood pressure falls, drastic measures are necessary. The most valuable is the intravenous administration of large quantities of physiologic salt solution. Two liters may be given slowly within from twenty to thirty minutes; if necessary, this procedure may be repeated every six hours. It is important that the salt solution be given slowly. It may also be given subcutaneously, although its influence is more promptly felt when it is administered in the vein. Glucose in isotonic solution may be given alternately with the salt solution.

If the pulse remains fairly good and the blood pressure does not fall alarmingly, it is permissible to depend on the rectal administration of fluids, either in the form of plain tap water or as salt solution; if in the milder cases the fluid thus given is largely retained, intravenous administration may be omitted.

Anuria is a frequent accompaniment of severe cholera. This and the nephritis which frequently follows are no doubt due to the influence of the cholera toxin as well as to dehydration. It is easier to prevent than to treat the patient for this condition, and for this reason an abundance of fluids should be supplied from the outset and the circulation by this means kept at the best possible level.

The statement that nothing but water should be given by mouth during the height of the disease should be qualified, for it has been found that kaolin taken orally in large amounts is of definite value. Strong quotes the experience of Kühne during the Balkan Wars, in which he was able by means of kaolin to reduce the mortality of this disease from 45 per cent to 2 or 3 per cent. The action of this substance is probably both mechanical and adsorptive; through purely mechanical influences on the mucosa of the stomach and intestines it controls vomiting and lessens diarrhea, and through its adsorptive qualities it probably takes up a part of the cholera toxin. One hundred grams of kaolin is suspended in a quarter of a liter of water, and the patient is instructed to take a glassful cold every hour or half hour; about six glasses carrying approximately 200 Gm. of kaolin in the first twelve hours is said to be sufficient. On subsequent days it should be taken at longer intervals. If necessary it may be given through a stomach tube. Perhaps the method of Walker is better: a large supply of kaolin suspension in water, half and half, is placed at the bedside; the patient is encouraged to drink of this at frequent intervals and in as large amounts as possible.

Coffee furnishes another exception to the rule, for it is of benefit both as a stimulant to the circulation and as a diuretic. Black coffee may be given by mouth if it is well borne; otherwise it should be given by rectum.

If the patient does not die during the stage of collapse, he later enters on a period of reaction, the chief dangers of which are hyperpyrexia and continued anuria. Complete abstinence from food should be continued for a time, but as he recovers his equilibrium the simpler foods may be given. In view of the frequency of nephritis in cholera, the first food of convalescence should consist of strained cereals and cream with milk and fruit juices; later, other foods may gradually be added.

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CHAPTER XX

DISEASES OF THE HEART AND ARTERIES

THE HEART

The work of the heart is materially influenced by the state of the nutrition. This was especially obvious in Germany during the hunger blockade of the World War, and has been commented on by Kraus[1] and others. People who were forced to subsist on a diet grossly inadequate in total caloric value and lacking in protein showed not only so-called hunger edema, but also well defined cardiac disturbances. The heart was usually smaller than normal, although it was sometimes dilated, and the pulse, which was very slow, even as slow as 40 or 30, became faint and weak. A return to an adequate diet brought about a prompt correction of these disturbances. A condition of this kind is seldom seen in America, but occasionally something approaching it is encountered in people who, because of a desire to remain stylishly thin or from freak ideas as to diet, have starved themselves to the point of actual injury. Circulatory disturbances in obviously undernourished patients should suggest the possibility of myocardial weakness due to nutritional failure. The remedy is simple—a full, well balanced diet, such as is advised in the chapter on inanition.

The opposite of this condition, obesity, also causes weakness of the heart. There are four ways in which the excessive accumulation of fat can interfere with cardiac efficiency: 1. A lack of balance develops between the body mass and the strength of the heart on account of the increase in fat. The integrity of the heart and its mechanical efficiency may be unimpaired, but because of the increased body mass this organ is unable to meet comfortably the demands made on it. A vicious circle has been established; circulatory embarrassment restricts the fat person's activites, which in turn leads to the accumulation of more fat and, finally to a still greater degree of cardiac disturbance. 2. In other cases the heart itself partakes of the fatty change, and accumulation of fat on its surface together with the deposition of fat between the muscle bundles greatly lowers the efficiency of the myocardium. The increased body mass demands greater work of the heart, while deposition of fat within its walls makes it less able to meet these demands. 3. Large accumulations of fat in the abdomen interfere with the movements of the diaphragm, and may in this way limit heart action. 4. Finally, the atherosclerosis which often accompanies obesity may involve the coronary arteries to such an extent as to impair still further the efficiency of the myocardium.

Because of lessened cardiac efficiency, relative or absolute, obese people in greater or less degree experience dyspnea on exertion. It may be nothing more than a scarcely recognizable discomfort, but nevertheless it interferes with the person's activity. On the other hand, it may be so severe as to produce marked distress and even angina pectoris. Such patients often exhibit extrasystoles. The type of patient under discussion will often experience marked improvement in cardiac efficiency from reduction in weight. During a reduction cure, however, it is important that such patients be kept at rest and perhaps for a time even in bed. This is discussed fully in the chapter on Obesity.

Acute Infections of the Heart.—Infections such as endocarditis and the carditis which occurs in rheumatic fever require the type of diet advised for septic infections, the nature of the food and the frequency of feedings depending somewhat on the severity of the illness. The ideal diet is the one which will provide adequate nourishment and at the same time require the least possible exertion of the patient. Liquid and semiliquid foods, such as milk, thickened broths, cereals with cream and soft boiled eggs, should be given in small amounts at frequent intervals, say about every three hours. Orange juice and other fruit juices form desirable additions. In subacute and chronic cardiac infections a more liberal diet containing a little tender meat and well cooked vegetables may be permitted. The regimen recommended for pneumonia is designed primarily to throw the least possible burden on the heart, and therefore as a rule it is suitable in acute diseases of the heart.

Chronic Myocardial Disease.—Such disease with or without a valvular lesion requires a diet which will give the patient adequate nourishment, but which at the same time will not permit his weight to exceed the normal. The chief object of all treatment of chronic myocardial disease is to rest the heart, and one of the most important things to this end is the reduction of the patient's weight. The less he weighs, the less will be the work demanded of the heart. At the same time, it is necessary to protect the patient against the ill effects of inadequate nutrition; for nutritive failure frequently produces, among other disasters, a weakening of the heart muscle. Undernutrition is permissible for short periods in order to get rid of the body fat, but a diet which is to be observed over long periods of time should be well balanced and should contain calories and protein to meet the patient's needs.

Reduction cures have been discussed elsewhere. It was emphasized there that the reduction of a patient with heart disease, particularly when decompensation is present, should be undertaken slowly and cautiously. The patient should preferably be in bed. The loss in weight should not exceed from 2 to 3 pounds weekly. Markedly overweight patients with cardiac disease should not be brought to the ideal weight in one course of treatment; it is best to reduce such patients' weight 20 to 25 pounds during one period, and then, after this new weight has been maintained for two or three months, to reduce the weight still further later.

The correction of constipation adds to the well-being of the patient with cardiac disease, and for this purpose he should be given not only an abundance of green vegetables and fruits, but also perhaps bran and agar. It does not seem necessary to forbid coffee and tea, but the amount of these beverages should be carefully controlled. One cup of coffee for breakfast and perhaps a little weak tea for the midday or evening meal is proper.

Myocardial Failure.—A Diet Rich in Carbohydrate, in which sugar and sugary foods find a prominent place, is often of value in myocardial failure. The ease with which sugar is assimilated and utilized for the production of energy makes it especially valuable in conditions such as this when it is desirable that the patient obtain abundant energy from his food with the least possible effort. The patient with myocardial failure can sometimes experience the same "pick up" from sugar which the mountain climber or marathon runner obtains when he eats sweet chocolate. This has been demonstrated by Edmunds and Cooper[2] who induced myocardial disease and circulatory failure in dogs by means of diphtheria toxin and then were able by means of intravenous injections of a 10 per cent solution of glucose to stimulate the heart and restore the circulation. Salt solution and acacia were valueless for this purpose, and these experimenters concluded that the remarkable improvement seen in these animals was due to the nutritional value of the glucose.

Clinical evidence[3] also attests the value of readily assimilable carbohydrate in the myocardial failure of man. The diet should be: (*a*) adequate in caloric value, (*b*) low in salt; (*c*) of relatively low protein content, (*d*) fairly liberal in fat, and (*e*) abundant in easily assimilated carbohydrate; a relatively large part of the carbohydrate should be in the form of sugar and sugary foods. If there is edema the total fluid intake should be restricted to about 1,500 ccm. In the severer cases the diet should provide approximately: Protein Gm. 50, Fat Gm. 100, Carbohydrate, Gm. 220 with a total caloric value of about 2,000. As the patient improves the diet may be enlarged both as to variety and as to the energy value. Of the six ample dietaries given below the first three are suitable for the first week or ten days of myocardial failure and the last three for the succeeding two or three weeks.

SPECIMEN MENUS SUITABLE IN MYOCARDIAL FAILURE

I.

7 a. m.	½ c. orange juice with 3 level tsps. sucrose and ice.

Breakfast:

8:30	2 h. tbsp. cooked cereal and served with 2 tbsp. cream and 5 level tsp. sucrose or granulated sugar. ½ c. milk with 2 tsp. glucose, pure syrup or sugar.
10 a. m.	½ gl. water or ice.
11	½ c. milk and 2 tbsp. cream.

Dinner:

1 p. m.	Soup (1 small potato, ½ c. milk, 1 tsp. butter). ½ c. junket (½ c. milk, 2 tbsp. cream, 2 h. tsp. sugar or pure syrup flavored ½ junket tablet) ½ gl. water.
3 p. m.	½ gl. orange juice with 2 h. tsp. sugar or lactose.
4 p. m.	1 gl. crushed ice.

Supper:

6 p. m.	2 h. tbsp. green vegetable put through sieve with 1 tsp. butter. Egg custard (1 egg, ½ c. milk, 2 tbsp. cream, 2 h. tsp. lactose or granulated sugar) ½ gl. water.
8 p. m.	½ gl. milk with 2 tbsp. cream. 1 tsp. dextrin-maltose. Approximate values: Protein 45, fat 105, car. 204, cal. 1,945.

Cardiac Diet:

II.

7 a. m.	Juice of 1 a. orange with 1 tbsp. lemon juice. 3 tsp. sucrose and 3 tsp. glucose

Breakfast:

8 a.m.	3 tbsp. well cooked strained oatmeal with 3 tsp. sucrose and 3 tsp. glucose. 2 tbsp. a. cream and ½ gl. milk.
9 a. m. or 10 a. m.	½ glass water with crushed ice.
11	Lemonade made with juice of ½ lemon and e. crushed ice sweetened with 2 tsp. dextrin-maltose and 1 tsp. sucrose.

Dinner:
12:30 p. m. Puree of spinach soup {2 h. tbsp. spinnach, ½ c. milk, 2 tbsp. cream, 1 tsp. butter.}
Boiled or soft custard (1 egg yolk, ½ c. milk, 1 h. tsp. sugar)
½ glass milk.
Water or ice, ½ gl.
3:30 p. m. ½ glass milk with 2 tbsp. cream flavored with dextrin-maltose, 2 tsp. and sucrose, 1 tsp.
4:30 Gl. crushed ice.

Supper:
6 p. m. 1 h. tbsp. thoroughly mashed potatoes with 1 tbsp. butter and 2 tbsp. all cream.
2 h. tbsp. ice cream.
½ glass water.
8 p. m. 1 egg shaken with ½ gl. milk, sweetened with 1 tsp. dextrin-maltose and ice.
Approximate values: Protein, 51; fat, 104; car., 205; cal. 1,963.
7 a. m. ½ glass water.

Breakfast:
8 a. m. 3 tbsp. strained oatmeal with 2 tbsp. cream and 1 tbsp. honey or 5 tsp. sugar.
½ gl. milk with 2 tbsp. cream and 3 tsp. glucose or sugar.
9 a. m. 1 c. crushed ice.
10 a. m. ¾ gl. orange juice with 2 h. tsp. sugar.

Dinner:
12:30 Spinach puree (2 tbsp. spinach, 2 tsp. butter, 2 tbsp. cream)
Egg custard (1 egg and one egg white, ½ c. milk, 2 tbsp. cream, 3 tsp. lactose or sugar)
½ gl. water.
3 p. m. ½ c. milk with 2 tbsp. cream and 4 tsp. dextrin-maltose or sugar.
4:30 Gl. crushed ice.

Supper:
6 p. m. 2 h. tbsp. mashed potatoes, with 1 tsp. butter.
2 h. tbsp. spanish cream.
½ gl. water.
8 p. m. ½ gl. milk with 4 tsp. sugar or pure syrup.
2 h. tbsp. snow pudding.
Approximate values: Protein 50, fat 100, car. 201, cal. 1,904.
IV.
7 a. m. ½ gl. orange juice with 1 h. tsp. sugar.

Breakfast:
8 a. m. 2 h. tsp. cooked cereal with 3 tbsp. cream.
2 h. tbsp. sugar.
1 small piece toast with 2 tsp. butter and 2 tsp. jelly.
½ gl. milk with 1 tsp. honey.
9 a. m. ½ glass water or crushed ice.
10 a. m. 4 tbsp. grape juice or crushed ice.

DINNER:

12:30 2 tbsp. greens of any kind, put through sieve (2 tsp. butter, 1 small sl. toast)
3 h. tbsp. floating island made with (½ tsp. cornstarch, 1 h. tsp. sugar, 1 egg, 1 c. milk).
3 p. m. Crushed ice, 1 c.
4 p. m. ½ c. milk and 4 tbsp. cream and 2 tsp. dextrin-maltose or sugar.

SUPPER:

6 p. m. Small baked potato with 2 tsp. butter.
1 soda cracker (unsalted).
Apple whip (1 tbsp. apple sauce, 1 egg white, 2 tsp. lactose or sugar).
½ gl. milk with 2 tbsp. cream and 2 tbsp. glucose.
8 p. m. 2 h. tbsp. ice cream.
½ gl. water.
Approximate values: Protein 49, fat 104, car. 216, calories, 2,032.

V.
7:00 a. m. ½ gl. orange ice (juice, ice, 3 tsp. sugar).

BREAKFAST:

8 a. m. 4 tbsp. corn meal gruel (2 tbsp. meal, 2 c. milk) sweeten with 1 tbsp. honey.
4 tbsp. cream.
1 small sl. toast, 2 tsp. butter.
½ tbsp. jelly.
9 a. m. ½ c. water or crushed ice.
10 a. m. ¾ gl. milk with 4 tsp. dextrin-maltose or sugar.
1 tsp. glucose or syrup.

DINNER:

12:30 p. m. Potato soup (1 potato, ½ c. milk, 2 tsp. butter).
2 soda crackers (unsalted).
2 h. tbsp. ice cream.
½ glass water.
3 p. m. ¾ gl. milk and 3 tsp. sugar or pure syrup.
4 p. m. Gl. crushed ice with 2 tbsp. grape juice.

SUPPER:

6 p. m. Puree of spinach or greens (2 h. tbsp. spinach, 2 tsp. butter, 1 tbsp. cream).
1 small sl. toast.
1 tsp. butter.
3 h. tbsp. tapioca cream made with (2 c. milk, 1 egg, 3 tbsp. tapioca, 2 tbsp. sugar).
8 p. m. 34 gl. milk.
Approximate values: Protein, 48; fat 102; car. 229; cal. 2,020.

VI.
7 a. m. 1 gl. crushed ice with 2 tbsp. grape juice or other fruit juice.

BREAKFAST:

8 a. m. 2 h. tbsp. strained oat meal, 5 tsp. sugar, 5 tbsp. cream.
1 sl. toast with 2 tsp. butter.
½ tbsp. honey or jelly.
½ gl. milk.
9 a. m. C. crushed ice.
10 a. m. ½ gl. orange juice with 2 tsp. sugar.

DINNER:	
12:30 or 1	Small baked potato with 2 tsp. butter. 1 spoon well cooked spinach. 1 soda cracker. Prune souffle (½ c. sieved prunes, 1 egg white, 2 tsp. lactose).
3 p. m.	Crushed ice, ½ gl.
4 p. m.	½ c. milk and tbsp. cream and 4 tsp. dextrin-maltose.
SUPPER:	
6 p. m.	Puree of carrots (3 tbsp. carrots, well mashed, 1 tsp. butter, 4 tbsp. cream). 1 small sl. toast, 1 tsp. jelly. Junket (½ c. milk, 2 tbsp. cream, 2 tsp. sugar or syrup, ½ junket tablet).
7 p. m.	½ c. crushed ice.
8:30 p. m.	½ gl. milk. 2 h. tbsp. baked custard, made with (1 c. milk, 1 egg, 2 tbsp. sugar). Approximate calories 2,261.

The Karell milk cure[4] is suitable for brief periods in patients with myocardial failure, and especially in those who are edematous. In its strictest form this diet permits the patient four glasses of milk (800 cc.) in the twenty-four hours and no other food; little additional fluid is given. This is obviously a starvation diet and one which contains only a small amount of fluid and little salt; therefore it cannot be continued long. After about four days the milk should be increased to 1,000 cc., and other simple foods, soft boiled eggs, toast with unsalted butter and preserves and cereals with cream should be added. The patient should remain in bed during the continuance of the Karell diet and should be under close observation. Occasionally this procedure brings about rapid disappearance of the edema and definite improvement in cardiac efficiency.

Bantick and Smith,[5] for the benefit of patients who dislike milk and to whom the monotony of the Karell diet is irksome, have modified this diet in a way which they believe obviates these disadvantages and yet brings but slight variation in the composition. They permit the patient water or pellets of ice sufficient to bring the total intake of fluid in water and food to 700 ccm. The food selected by them is prepared without adding salt; it is weighed and served as follows:

MODIFIED KARELL DIET OF BANTICK AND SMITH
COMPOSITION OF DIETS

Diet	Carbohydrate	Protein	Fat	Water	Calcium	Magnesium	Potassium	Sodium	Phosphorus	Chlorin	Sulphur	Ferrum
Karell	40	24	32	696	0.96	0.096	1.144	0.408	0.744	0.848	0.272	0.0019
Modified Karell Bantick & Smith	53	26	40	465	0.40	0.073	0.866	0.583	0.550	0.852	0.368	0.010

Breakfast

Bread (toast)	10 Gm.
Ten per cent fruit (orange)	100 Gm.
Sugar	5 Gm.
Egg	1

Dinner

Bread	10 Gm.
Cream soup	150 Gm.
Butter	5 Gm.

Supper

Bread	10 Gm.
Milk	200 Gm.
Butter	10 Gm.
Egg	1

Anorexia and nausea sometimes present a serious problem in the feeding of the patient with heart disease. It may be possible in such cases to rearrange the diet so that itwill appeal to the patient, and thus enable him to keep it. It is well to remember that patients will sometimes retain solid foods when they cannot keep liquids, and also that it may be necessary for a time to violate the rule regarding highly seasoned foods.

Angina Pectoris.—This condition may be influenced by care in diet. The instances of death from acute indigestion published in the daily papers usually represent angina pectoris precipitated by a very heavy meal. While diet obviously cannot remove the underlying cause of angina, careful feeding will often relieve somewhat the burden on the heart and thus lessen the frequency of the attacks. The food should be simple; easily digested dishes should be taken, and the meals should be small. If necessary, a glass of milk or other light food may be taken between meals. There is no reason for eliminating meat from the diet; the patient may be permitted one small helping daily. The same may be said of salt and other seasonings; small amounts may be permitted, but larger quantities should be avoided. Alcohol had best be eliminated entirely. One cup of coffee daily may be permitted.

THE ARTERIES

Arterial Hypertension.—This condition was discussed with nephritis.

Arteriosclerosis.—In spite of a vast amount of experimental work, arteriosclerosis is yet of unknown etiology. True, Newburgh[6] and his associates have been able to produce arterial disease in rabbits by feeding high protein diets; and Anderson[7] has seen atherosclerosis of the aorta (but not of the small arteries) follow a high protein diet in rabbits from which a large part of the kidney substance had previously been removed. But this does not explain the generalized arteriosclerosis which with advancing years appears in all of us, nor does it agree with the generally accepted pathology of this disease.

In Aschoff's[8] description of the pathology of atherosclerosis one sees clearly that the first changes in the vessel walls are fatty, an "intimal fatty change," and that the atherosis, which precedes the actual sclerosis, begins at a relatively early age, perhaps as early as 16 or 18 years. As evidence of the early beginning of this process, he quotes the following observations as to the frequency with which atherosclerosis was seen in young men in the prime of life who were killed in the World War.

Under 20 years..........	14 cases, of which 5 showed atherosclerosis (35.*a* per cent)
Under 25 years..........	45 cases, of which 34 showed atherosclerosis (75.6 per cent)
Under 30 years..........	20 cases, of which 18 showed atherosclerosis (90 per cent)
Under 35 years..........	15 cases, of which 12 showed atherosclerosis (80 per cent)
Under 40 years..........	16 cases, of which 16 showed atherosclerosis (100 per cent)
Under 45 years..........	1 case, of which 1 showed atherosclerosis (100 per cent)

While the primary change of atherosclerosis is a fatty one due to some lipoid disturbance, it seems likely, as Aschoff points out, that the determining factor in the last analysis is the strain to which the vessel is subjected. He believes that this sclerotic process is common to all body structures, that it is not limited to the vascular system, and that it is most striking in the vessel wall because the vascular system is the organ which is subjected to greatest strain. From considerations such as these, it is hard to believe that the eating of liberal amounts of protein or of salt can be a dominant factor in the production of atherosclerosis.

After all, there is only one factor in the production of arteriosclerosis about which we can speak with any degree of certainty: heredity, or constitutional predisposition. What is back of this no one can say. Since the factors concerned in the production of arteriosclerosis, other than mechanical strain and constitutional predisposition, are unknown, it is evident that dietaries which are designed to prevent this disease represent mere guesswork.

For patients who are already arteriosclerotic, however, and whose organs are handicapped by an impaired circulation, something can be accomplished by limitation of food; for judicious dietary restriction may lessen appreciably the burden thrown on the various organs. To avoid vascular accidents, the patient's blood pressure should be kept as close to the normal as possible; in this endeavor, the reduction of body weight is of value. Obese patients with arteriosclerosis become much more comfortable and their longevity is enhanced after their weight has been reduced. The regimen advised above for arterial hypertension is suitable in arteriosclerosis. Moderation in everything is demanded. The patient should have a well balanced diet which carries an abundance of green vegetables, and a reasonable amount of meat, say one average helping of any tender meat from four to seven times weekly. He may take one or two eggs each day. This is designed to give an average protein intake of from 60 to 100 Gm. daily. If there is evidence of renal impairment, the protein content of the diet should approach the smaller amount; if there is no renal disturbance, it may reach the upper figure.

The sodium chloride intake should be reduced to a reasonable figure, but there is no advantage in rigid chloride restriction. A total of 2 to 4 Gm. of sodium chloride daily, perhaps a little more, may be permitted.

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CHAPTER XXI

DISEASES OF THE BLOOD

SECONDARY ANEMIA

The removal of the cause of the anemia comes first. The cure of bleeding hemorrhoids or of a gastric ulcer, or the recognition and treatment of ankylostomiasis, malaria, sepsis, syphilis or other infection may be necessary before dietary treatment can be effective.

The metabolism of the patient with secondary anemia does not differ from that of the normal person. Therefore the aims of dietary regulation should be: (1) to provide a diet which contains all of the necessary nutritive elements in proper amounts, a well balanced diet; and (2) to give in addition an abundance of those articles which according to clinical experience and animal experiment best promote blood regeneration.

The first of these aims requires little discussion. Because the patient's digestion is often impaired it is advisable to give simple, easily digested foods, among which milk and eggs should always find a prominent place. In spite of its lack of iron, milk is an important food for the anemic patient; a quart a day is desirable. Bread, toast with butter, preserved fruits, and cereals with cream should also be taken in abundance. In the attempt to provide a concentrated high calorie diet there is always the danger that the patient may not get enough vitamins and minerals; for this reason it is essential that lettuce, spinach, tomatoes, orange juice and other foods rich in these elements be specified.

The second consideration involves the inclusion in the diet of an abundance of good protein, particularly of liver and kidney. The studies of Whipple and his coworkers, as well as others, have shown that an animal makes good his losses after a severe hemorrhage much more rapidly if given an abundance of meat; and the more recent observations of Whipple and Robscheit[1] have demonstrated the great value of liver in this respect. They state that "the favorable reaction to liver feeding is a sustained and uniform maximum." The diet of patients with secondary anemia should therefore include liberal amounts of good protein in the form of muscle meats and liver. This type of diet is given in detail in the section on pernicious anemia. The regimen recommended there is suitable for patients with secondary anemia.

The anorexia and capricious appetite sometimes exhibited by these patients may present a bar to successful feeding. Dietary instructions should be given in great detail, and their strict observance enjoined. Sufficient variety in the kind of food must be provided, but too much latitude in the observance of the physician's directions should not be permitted.

The relative value of inorganic and so-called organic iron in blood regeneration has been discussed in the section on mineral requirement (see page 88). The conclusion was reached that while, for the construction of hemoglobin, the organic iron of the food is ordinarily drawn on first, inorganic iron in case of need is also readily utilized for the same purpose.

CHLOROSIS

Chlorosis is a well characterized type of anemia; while its exact nature is unknown, it presents certain salient characteristics which serve to distinguish it from the secondary anemias on the one hand and from pernicious anemia on the other. It usually appears in girls or young women about the time of puberty, and can often be recognized by the peculiar greenish pallor of the skin. The anemia is marked by a disproportionately severe diminution in the amount of blood pigment so that the individual red blood cells each contain less than the normal equipment of hemoglobin, with the result that the blood gives a low color index. Treatment will usually bring about an apparent cure, but relapses are frequent.

The cause of chlorosis is unknown, but there are reasons for believing that it is due to lack of development of the blood vascular apparatus, and that it is also related to development of the sexual organs. Perhaps it is an expression of inability on the part of the organism to meet the unusual demands of oncoming puberty. Since many of these patients are constipated and live under unhygienic surroundings, these deleterious factors have sometimes been given as a cause, but without adequate proof.

In the treatment of chlorosis certain hygienic measures should be combined with dietary control. The patient should be kept in bed during the earlier weeks of treatment in order to conserve her strength. She should have an abundance of sunlight and of fresh air. Sunbaths are of value; especial emphasis should be given to the advisability of exposing a large part of the patient's body to the direct rays of the sun; sunlight which has been filtered through window glass is of no value.

The dietary specifications are those which have just been given for secondary anemia: that is, a wholesome well balanced menu which contains, among other foods, a quart of milk daily, an abundance of lettuce, spinach and other green vegetables, tomatoes and fruits and a liberal amount of good protein. A large part of the protein should be in the form of muscle meats and liver. A liberal helping of these foods should be taken twice daily. Eggs, from two to four daily, should also be taken. Carbohydrates and fats may be added in amounts sufficient to provide the required caloric value. If the patient is obese, the amount of milk should be reduced to 1 pint, and no avoidable fats should be given. Pickles and other articles which are without food value should be permitted only in extremely small amounts.

Reference has already been made to the blood-building qualities of liver and perhaps of kidney. Therefore it is advisable that a large part of the protein be taken not solely as muscle meat but as liver and kidney. This type of diet is given in detailed form in the section on pernicious anemia; it is probably suitable also in chlorosis.

Constipation is frequently associated with chlorosis, and, since its relief is believed to be an important therapeutic measure, the presence in the diet of an abundance of roughage, such as comes with the green vegetables and fruits, is doubly important. The patient may be given each morning for breakfast a plate of bran with cream and sugar and perhaps stewed fruit. The administration of agar, say a tablespoonful twice daily after meals is sometimes also advisable. The agar may be taken with the bran and eaten as a breakfast food, but I believe that it is better to take it direct with the aid of a little water.

Ulcer of the stomach, which is a frequent complication of chlorosis, may interfere materially with the dietary regimen. The patient can still be given the necessary amount of protein in the form of milk and eggs, but it is not advisable to give meat. Whether it is possible to give kidneys and liver in the form of a thin, well cooked stew or puree remains to be seen. I have never tried this in ulcer of the stomach, although in the complication of diseases under discussion it should perhaps be given a trial.

The foods just advised contain an abundance of iron, and it might be assumed therefore that the administration of medicinal iron is unnecessary. Since, however, inorganic iron has a remarkably beneficial influence in chlorosis, it seems best not to rely solely on the food iron but to give in addition inorganic iron in the form of Blaud's pills.

PERNICIOUS ANEMIA

Pernicious anemia is a disease of the blood and the blood-making organs, the salient characteristic of which is hemolysis. Nägeli[2] believes that a profound change in the bone marrow, with the production of megaloblasts and megalocytes, comes first, and that the hemolytic anemia appears later. This is opposed to the view expressed by Morawitz to the effect that hemolysis comes first and that the changes seen in the bone marrow represent merely an effort on the part of this structure to make good the blood loss. All agree that the anemia is probably due to a hemolytic toxin which not only destroys red blood cells, but which also injures other structures, notably the mucous membrane of the tongue, stomach and intestine and certain structures in the spinal cord. The origin of this poison is unknown. It is possible that there are a number of hemolytic agencies, any one of which can produce the same clinical syndrome. The poison produced by *Bothriocephalus latus* causes an anemia which cannot be distinguished from pernicious anemia; syphilis is accompanied at times by an anemia of this character; in pregnancy also this type of anemia sometimes appears, the result presumably of unknown poisons, and permanently disappears after labor. Sprue is also accompanied by anemia and other symptoms which cannot be distinguished from those of pernicious anemia; in fact, the suggestion has been made that sprue and pernicious anemia are the same disease.

It seems fair, then, tentatively to assume that while pernicious anemia is a true clinical entity, it is probably not due to a single cause but may result from the action of any of several different hemolytic agents. Whenever the poison of a given hemolytic anemia is identified, it is no longer called pernicious anemia but is designated by its etiologic agent, and there remains in the category of true or cryptogenic pernicious anemia therefore merely the hemolytic anemias of unknown origin.

Before treatment is instituted, the disease should be properly identified. There is no short-cut to diagnosis. The blood picture and the other clinical features must be considered together in order to reach a satisfactory diagnosis: a low red cell count with a relatively large amount of hemoglobin, giving a high color index, say of 1.3 or

1.4; a normal or low leukocyte count with diminished platelets; the appearance of the red cells; the presence of megalocytes and megaloblasts, and, as Hayden has pointed out, a high volume index—all of these are salient characteristics. Weakness without loss of weight, slight edema perhaps, marked pallor, gastro-intestinal disturbances, anorexia, nausea, unaccountable diarrheas and gastric anacidity taken together suggest pernicious anemia.

Before discussing the value of diet and of other treatment, emphasis should be laid on the tendency of this disease to show remissions. For no accountable reason the patient with pernicious anemia may experience great improvement and remain in apparent health for several months. Sooner or later he has a relapse, and as time goes by the remissions become less frequent and of shorter duration. The possibility of these remissions makes the evaluation of any method of treatment especially difficult.

It is not necessary to review here the various diets which have been suggested. As a rule, in the construction of the older diets, ease of digestion and general nutritive value have been the determining factors rather than the stimulating influence of any particular food on the blood-making organs. Most clinicians agree that a diet liberal in protein is advisable, although some (Grawitz) have emphasized the value of fresh vegetables. The diet recommended by Barker and Sprunt[3] is the best example of the well balanced high calorie, high protein regimen. They advised an all-milk diet for the first few days, to which is added, a few days later, other foods in liberal amounts until a total intake of 4,000 or 5,000 calories is reached. Raw eggs and meat are given in liberal amounts. More recently Gibson and Howard,[4] while recognizing the value of iron-containing foods in pernicious anemia, emphasized particularly the constant loss of nitrogen. They concluded that positive nitrogen and iron balances may be established in this disease by a diet rich in food iron and comparatively low in calorie and protein values. Their studies confirmed the observations of Whipple as to the blood regenerating properties of muscle meat and liver. They gave fruits, green vegetables, lima beans, sweet potatoes, egg yolk and liver daily, with very little fat, in a dietary which provided about 1,900 calories.

A basis for the rational feeding of patients with pernicious anemia was formed by the work of Whipple and his associates.[5] These workers demonstrated the value of inorganic as well as organic iron in anemia of long duration, and showed also that blood regeneration takes place much more rapidly when an experimental animal is given liberal quantities of muscle meats and liver. The most promising of these contributions is their revelation of the remarkable value of liver as a blood-building food. The rationale of this lies no doubt in their further observation that the liver is the most important pigment building organ of the body and that it normally stores at all times the precursors of hemoglobin. In eating liver, the animal no doubt obtains large amounts of those building stones from which the hemoglobin molecule is constructed. It was on the information gained from this work that the dietary plan detailed below was based.

Minot and Murphy[6] devised a high protein diet for patients with pernicious anemia, the chief characteristic of which is its richness in good protein, largely in the form of calf's liver, and its extremely low fat content. The liver is given because of its beneficial influence on blood regeneration. The fat is restricted because lipoids are believed to have certain blood-destroying and growth-inhibiting properties, and also because it is assumed that digestion is better when the food does not contain too much fat. Liberal amounts of green vegetables and fruits are also prescribed.

These clinicians appear to have achieved remarkably good results from this diet. The daily requirements of their regimen in order of importance are:[7]

(1) Liver (calves', beef, chicken) or kidneys (lamb) freshly cooked. At least 120, preferably 200 or more, Gm. (cooked weight). Cook without fat; broil, bake, boil, mince or make into soup.

(2) Fruits, preferably fresh—especially peaches, apricots, pineapple, strawberries, oranges, and grapefruit—about 400 Gm. Raisins desirable; allow them to be eaten freely.

(3) Red muscle meat, trimmed free of fat, freshly cooked; 125 Gm. or more. Beef heart desirable.

(4) Vegetables containing 1 to 10 per cent, of carbohydrate, preferably fresh; cooked or raw. Not less than 300 Gm. Lettuce, spinach, asparagus, cabbage and tomato especially desirable.

(5) Fats restricted, not over 70 Gm. Avoid cheese, bacon, fried food. Allow but little cream and butter and not over one egg. Use mineral oil for salad dressings.

(6) Avoid grossly sweet foods, yet allow sugar sparingly.

(7) Starchy foods, as cereals, potato, breads, add to suit individual desires, but not to exclusion of the requirements given above. The starchy foods best be crusty or dextrinated. Whole wheat toast is desirable.

(8) Milk best be limited to about 240 Gm.

(9) Avoid excess of salt.

Tea and coffee as desired.

It is advisable that the liver be weighed, at least in the beginning, and preferably the other foods also. After this, approximate quantities may be taken. Several small feedings rather than three meals daily is advisable. The needs of the individual patient should be taken into consideration; for instance, for the patient with diarrhea, less fruit should be given and the vegetables should be prepared in the form of purees. A certain latitude of choice should be permitted. When the patient cannot take much food or when it is extremely distasteful, the liver and kidney may be prepared in puree form, and in case of necessity may be given through the stomach tube. The average person should receive about 2,500 calories distributed approximately as follows: protein, 135 Gm.; carbohydrate, 340 Gm.; fat, not more than 70 Gm. The following menus suggested are by the authors.[7]

Breakfast

I	Approximate weight in grams
Liver or kidneys, broiled	100
Oatmeal, 2 heaping tablespoons cooked, or dry meal	18
Milk, 3 tbsp	45
Sugar, 2 level teaspoons	10
Toast, 3 slices (each slice 4 × 2 × ¼ inches)	30
Butter, 1 level tsp. or a piece 1 × 1 × ½ inches	5
Fruits, choice of:	
(a) Orange, average size	120
(b) Strawberries, 5½ tablespoons	180
(c) Grapefruit, ½ of one very large one	200
(d) Peach, 1 large one	120

Dinner

Beef, steak or roast, trimmed of fat; a very large serving	120
Vegetables, freshly cooked, as spinach, string beans, cabbage, tomato, etc.; 2 average portions or 5 to 8 tbsp	250
Potato, baked, medium sized	130
Bread, 2 slices (each slice 3 × 4 × ½ inches)	70
Salad: Pineapple, 2½ slices, of size in cans	140
Lettuce, big helping	75
Pudding made of:	
(1) Gelatine, 1 tsp. (dry weight)	2
(2) Rice, boiled, 2 heaping tbsp	160
(3) Raisins, 20 large ones	50
(4) Milk, 2 tbsp	30

(Fruits may be put into such a dessert and raisins eaten separately.)

Supper

Liver soup, composed of:	
(1) Liver, minced	100
(2) Milk, 1 tumblerful	220
(3) Flour (white), 1 tsp	4
(4) Butter, 1 rounded tsp. or a piece 1 × 1 × ⅞ inches	10
Lamb, roast, without fatty parts, 2 small slices	60
Macaroni, boiled, 3 tbsp	150
or	
Potato, small one, or rice, 1 h. tbsp	80

Vegetables, fresh, 2 average portions 5 to 8 tbsp	250
Uneeda biscuits or triscuits, 4	25
Butter, 1 level tsp. or a piece 1 × 1 × ½ inches	5
Choice of:	
(a) Strawberries, 7 tbsp	225
(b) Orange, large one	150
(c) Apricots, or prunes, stewed, 2 tbsp	100
Sugar, 2 h. tsp	20

A vegetable soup could be taken in place of the liver soup and the liver eaten in the following form: Mince it and mix with rice or potato and the allowance of butter, and stuff into green peppers.

The following menu has also been suggested: calories, 2,050; protein 115 Gm., carbohydrate 250 Gm., and fat 65 Gm.

Breakfast

II.	Approximate weight in grams
Fruit, choice of:	
(a) Orange juice, from 2 oranges	130
(b) Grapefruit, 1 whole medium sized one	240
(c) Strawberries, 5½ tablespoons	180
Shredded wheat, 1 biscuit	30
Milk, 2 tbsp	30
Sugar, 1 level tsp	5
Beef, minced, 2 h. tbsp	75
Cream, 20 per cent, 4 tbsp	60
Toast, 2 slices (each slice 4 × 2 × ¼ inches)	20
Butter, 1 rounded tsp. or a piece 1 × 1 × ⅞ inches	10

Luncheon

Liver, broiled	120
Lettuce or cold slaw, large helping	80
Potato, cold, sliced, or baked, hot, 1 small one	80
Tomato, stewed, 5 tbsp., or raw, 2 medium sized ones	150
Cauliflower or Brussels sprouts, an average portion or 3 tbsp	130
Zwieback, 2 pieces	30
Butter, 1 level tsp. or a piece 1 × 1 × ½ inches	5
Apricots, stewed, 3 heaping tbsp	120

Dinner

Soup, consomme (any amount desired), mixed with sieved liver (flavor with spice)	75
Mutton, 2 large slices, trimmed of fat	100
Beets or peas, 3 tbsp	100
Potato, boiled, average size	130
Spinach, or string beans, an average portion or 3 to 5 tbsp	150
Butter, 1 level tsp. or a piece 1 × 1 × ½ inches	5
Toast, 2 slices (each slice 4 × 2 × ¼ inches)	20
Blanc mange, 2 heaping tbsp. (made of ¼ cup Irish moss, 2 cups milk, 1 tbsp. cream, 20 per cent, 2 tsp. sugar)	100
Blueberries, 5 tbsp., or apple sauce with 1 level tsp. (5 Gm.) of sugar: 2 tbsp	80

(Fruit could be mixed with blanc mange.)

The observations of Minot and Murphy were made on forty-five patients with typical pernicious anemia; for a detailed statement of their results, the reader is referred to their original article. It can be said briefly, that the patients took this diet well, and within a short time were greatly improved. It is unlikely that the good results seen by them can be credited to ordinary remissions. The improvement was of such constancy and of such duration that spontaneous remissions can apparently be ruled out. The average red cell count among the forty-five patients was in the beginning 1,470,000, and at the end of from four to six months of this diet 4,500,000. There was proportionate improvement in other respects. I have used this diet in a few cases of pernicious anemia, with apparent success. A striking example is a patient who has had outspoken pernicious anemia for four years. He has been given thirty-eight blood transfusions with ever increasing frequency, and when he began his diet one year ago it was becoming increasingly difficult even with transfusion to put him on his feet. Since this time he has been in excellent health, and his red cell count now is in excess of 4,000,000. No such improvement has been seen at any previous time during the two years that he has been under observation. Other patients with pernicious anemia have shown similar improvement.

One possible objection to this diet should be noted. Its high purin content would no doubt precipitate trouble if it were given to patients who also have gout; it may conceivably lead to true gout in those whose metabolic tendency is in this direction.

It is too early to attempt a final evaluation of the diet proposed by Minot and Murphy. Disappointments have been numerous in treatment of patients with pernicious anemia, and only too frequently remedies which at first promised much have later been cast aside as useless. At this writing the diet outlined seems to give greater promise than anything which has been tried before.*

Other methods of treatment should not be neglected because treatment by regulation of diet seems promising. Complete rest in bed in the severer cases, the administration by mouth of diluted hydrochloric acid and of Blaud's pills, and blood transfusion are all of value.

PREPARATION OF CALVES LIVER FOR PERNICIOUS ANEMIA DIETS†

Liver Juice: Score the raw liver and sear slightly in a pan, for less than a minute. Place the seared liver in a square made of gauze (several folds) and squeeze out the juice. About 150 cc. of juice from 2 lbs. of liver. *Serve cold.* Orange juice may be taken after it.

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* An extract of liver in powdered form has been prepared and it is said that this exhibits to a remarkable degree all of the curative properties of whole liver.

† Reprinted from the Journal of the American Dietetic Association, Vol. II, No. 3, December, 1926. Thelma Tubbs, B. S., and Elizabeth Bellinger, B. S., Peter Bent Brigham Hospital, Boston, Massachusetts.

Broiled Liver: Dash liver in hot water, remove the skin, and broil until done, or pan broil in mineral oil. Five minutes are generally allowed for cooking.

Scraped or Sieved Liver: Dash liver in hot water and remove the skin. Broil the liver 5 to 10 minutes (until cooked through) and scrape through sieve, or press through potato ricer.

Liver Stuffed in Green Peppers or Tomatoes: Stuff sieved or finely chopped liver (cooked) which has been moistened with tomato juice or broth, in the tomato or green pepper and bake. Onion may be added to the chopped liver for flavor. One pepper or tomato will hold 60 grams of liver.

Liver Soup: Add 90 Gm. of scraped or *sieved liver* to 200 cc. of clear *tomato* or chicken broth with fat removed. Season with onion if desired.

Liver Soup (Creamed): 120 Gm. chopped liver, 220 cc. milk, 4 tsp. flour, 10 Gm. butter. Make white sauce and add liver.

LEUKEMIA, PURPURA, HEMOPHILIA

The leukemias require no special form of diet. The food should be simple and, as far as possible, well balanced. The severity of the illness, the degree of prostration and any possible difficulties in swallowing must determine the character of the food and the frequency of feedings.

Purpura is a symptom rather than a disease, and the patient should partake of a diet suited to the underlying disorder. The possibility of scurvy should be kept in mind.

Hemophilia is probably uninfluenced by diet, but as there is evidence to the effect that the administration of calcium is of benefit, it is advisable to give the patient large quantities of milk and milk products.

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CHAPTER XXII

DISEASES OF THE JOINTS

CLASSIFICATION OF ARTHRITIS

Many forms of arthritis are frankly infectious and therefore are uninfluenced by diet. There are, however, other forms of unknown etiology, some of which are possibly related, closely or remotely, to metabolic disturbances, and which therefore may be subject to dietary control. At least one arthropathy, gout, is of known metabolic origin, and can be radically influenced by the proper selection of food.

The classification of diseases of the joints has always been difficult; uncertainty as to cause has made it impossible to secure a good grouping from an etiologic standpoint, while an arrangement according to clinical signs has apparently been equally unsatisfactory. The best division today, that of Nichols and Richardson,[1] is based on pathology, on the anatomic and histologic changes which occur in the diseased joint. These authors recognize two broad types of arthropathy: (1) proliferative arthritis, those diseases which arise primarily from proliferative changes in the joints chiefly in the synovial membrane and in the perichondrium; and (2) degenerative arthritis, those diseases in which degeneration of the joint cartilage is the primary feature. While these two groups are characterized by distinct gross and histologic differences, so that each presents a fairly well defined clinical picture, they do not in any sense correspond to two definite etiologic factors; therefore they must not be regarded as etiologic entities.

It is not difficult to distinguish between these two major types of arthritis. The proliferative type begins with changes in the synovial membrane which leads to proliferation of this membrane and eventual destruction of the cartilaginous tissue. This may involve the capsule and other periarticular structures, with resulting increased growth of the perichondrium and formation of new bone. Roentgenograms at first show very little, but later there is clouding of the interarticular space and finally partial or complete ankylosis. This type of arthritis produces pain, swelling and limitation of motion. It is usually progressive and may move from joint to joint. Arthritis deformans is typical of this group.

The degenerative arthritis occurs in people who are "physiologically old." There is a degeneration of the cartilages of the articular surfaces with eventual exposure and hardening of the bone, but as a rule no ankylosis. There is in this type less evidence of inflammatory reaction. Roentgenograms frequently show lipping and other evidences of new bone formation around the joint. It is usually limited to one joint, and the progress of the disease is slow. The best example is seen in the arthritis which occurs in fat women about the time of the menopause.

Cecil and Archer,[2] in their studies of 612 cases of chronic arthritis in the Cornell Clinic, adopted this classification, and grouped their cases as follows:

Table 1.—*Classification of* 612 *Cases of Arthritis* (*Cecil and Archer*)

	Cases
A. Proliferative Arthritis	
1. Chronic infectious arthritis, referable to foci of infection	379
2. Specific arthritis, caused by specific bacterial infection. (Gonococcal, tuberculous, septic, etc.)	18
3. True arthritis deformans, a chronic progressive polyarthritis of unknown origin	17
	414
B. Degenerative Arthritis	
1. Arthritis of the menopause	145
2. Degenerative monarticular arthritis	20
3. Senile arthritis	17
Total	182
C. Other Forms	
1. Gout	4
2. Intermittent hydrops articulorum	2
3. Unclassified	10

DIET IN ARTHRITIS

Acute Arthritis.—Acute arthritis such as is seen in rheumatic fever, gonorrhea and sepsis, is uninfluenced by diet. Sweets, meats, fruits and various other articles of diet all have been said from time to time to be harmful in rheumatism, but it is probable that these beliefs go back to the days when gout was confused with other forms of arthritis. Patients with acute arthritis require no dietary limitation except such as is made necessary by the enforced rest, fever and possible systemic disturbances. A simple, easily digested diet consisting largely of milk, eggs, cereals with cream, toast, butter and preserves, orange juice, ice-cream and the simpler puddings, is desirable. To this should be added for the anemic patient, because of its blood building qualities, a little broiled calf's liver or a puree made of liver and kidneys (see anemia, page 639). If there is no fever, the patient should be permitted the ordinary normal diet, including a liberal quantity of meat, with such restriction of total caloric intake as is made advisable by enforced idleness.

Chronic Infectious Arthritis.—This type of arthritis, which comes from focal infection, is not amenable to diet, but the debility and the anemia which often accompanies these infections can be materially reduced by the careful selection of food. A nourishing diet which includes not only sufficient vitamins and minerals but also liberal quantities of good protein, chiefly as muscle meats and liver, is desirable. After the focus of infection has been removed, blood regeneration proceeds much more rapidly if the patient partakes of blood-building foods of this character. For patients who are undernourished and anemic the diets advised by Minot and Murphy for pernicious anemia (see page 635) slightly modified, or those given below, are suitable.

DIETS IN INFECTIOUS ARTHRITIS

SPECIMEN DIET 1

		Protein	Calories
BREAKFAST:	1 orange, 1 pear, or ½ cantaloupe	1	
	1 tbsp. grapenuts with ¼ glass milk	4	
	1 poached egg on average slice	6	
	toast with 2 slices crisp bacon	6	
	1 cup coffee with 2 tsp. sugar and 2 tbsp. cream	2	563
10:30:	1 glass milk	..	157
		25	720
DINNER:	Average sized helping roast chicken	32	
	2 tbsp. boiled rice	6	
	2 heaping tbsp. spinach with	2	
	1 hard boiled egg	6	
	Medium sized tomato salad with lettuce and 1 tsp. mayonnaise	3	
	2 a. s. slice bread or roll	6	
	Fruit cup (½ each a. s. orange and grapefruit)		
	1 glass milk	7	
	1 tbsp. butter	..	1,143
4 p. m.:	1 glass milk	7	157
		69	1,300

		Protein	Calories
Supper:	A. h. liver	20	
	Boil and serve with brown sauce made with 1 tsp. butter, 1 tsp. flour; season.		
	2 h. tbsp. butter beans	6	
	Creamed celery	2	
	A. h. lettuce salad with 1 tbsp. Thousand Island dressing.		
	Egg custard made with 1 egg, ⅔ glass milk and 1 tsp. sugar, nutmeg or vanilla	10	
		38	
	2 slice whole wheat bread	8	
	1 tbsp. butter		
	1 glass milk	7	
Bedtime:	1 a. s. apple	..	72
		53	1,290
	Total	147	3,360

Specimen Diet 2

		Protein	Calories
Breakfast:	1 large baked apple	1	
	2 h. tbsp. oatmeal with	3	
	1 tsp. sugar and 2 tbsp. cream	2	
	2 egg omelet with 3 strips crisp bacon	17	
	2 whole wheat muffins; 1 tbsp. butter	8	
	1 cup coffee with 1 tsp. sugar and 2 tbsp. cream	2	
		33	1,144
Dinner:	2 a. s. sl. roast beef (lean)	47	
	M. s. baked white potato	4	
	4 h. tbsp. string beans	1	
	Dandelion or spinach salad on lettuce with 2 tsp. mayonnaise	2	
	2 corn muffins or 2 sl. bread	6	
	Canned peaches (2 halves)	1	
	1 glass milk	7	
4:	1 glass milk	7	157
		75	1,099
Supper:	Large helping liver	40	
	2 h. tbsp. carrots	1	
	3 tbsp. mustard or turnip greens or any greens	1	
	Asparagus (5 stalks on lettuce) salad with 1 tbsp. mayonnaise	1	
	2 slices whole wheat bread	8	
	2 tbsp. orange ice	1	
	1 gl. milk	7	1,115
Bedtime:	1 medium orange	2	96
		61	1,211
	Total	169	3,454

Arthritis Deformans.—This type of arthritis is probably of unknown etiology, although it is believed by a few clinicians to be merely a chronic form of infectious arthritis. The tendency toward symmetry of involvement, the periarticular infiltration with thickening of the capsule, the ulnar deviation of the hands and fingers and the early ankylosis serve to distinguish it from the other forms of chronic arthritis. Rigid restriction of protein, as is sometimes advised, is of no advantage in this disease, nor does any other form of dietary restriction accomplish anything of value unless it be that Pemberton, whose views will be discussed below, is correct in his belief that this as well as other forms of chronic arthritis is beneficially influenced by a low calorie diet of limited carbohydrate content.

Degenerative Arthritis.—This type occurs in people who are growing old. Obesity and arteriosclerosis are frequent accompaniments. The arthritis of the menopause appears most often in women who are fat, and, while it may involve several joints, it most often attacks only the knee. This slowly progressive arthritis is difficult to influence, but judicious reduction in weight will often halt the disease and add greatly to the patient's comfort. Reduction cures and menus will be found on page 394.

Except for possible disturbance of carbohydrate utilization as noted below, the metabolism of chronic arthritis does not differ essentially from the normal.[3] High blood calcium, however, has been noted and the suggestion made that there is some disturbance of calcium metabolism; but diets low in this element have been prescribed without benefit.[4] The stimulation of metabolism by thyroid substance is often of value. In patients who are overweight, a low calorie diet which includes an abundance of vegetables, such as will permit a gradual loss of weight, is best.

LOW CALORIE DIETS

Pemberton[5] has observed that patients with chronic arthritis have hyperglycemia with lowered glucose tolerance, and he believes that the extent of this metabolic anomaly can be taken as a rough index of the severity of the disease. In explanation of this he has experimentally adduced evidence that changes in the circulation of the blood in and around the inflamed joint interfere with the normal mechanism by which the muscle removes sugar from the blood.[6] Other clinicians also have observed in chronic arthritis the same lowering of glucose tolerance. Whatever may be the relation of this anomaly of carbohydrate metabolism to the arthritis, Pemberton has seen marked improvement follow dietary restriction, particularly as to carbohydrates. This author[7] is wisely insistent, however, that dietary control should not be the sole therapeutic effort. Other valuable methods of treatment used by him are: the removal of foci of infection, the reduction of obesity, the application of heat, massage, etc.

Similar views as to the influence of food are held by Fletcher,[8] who studied the effect of dietary restriction on one hundred patients who had chronic arthritis and noted marked improvement in forty-six. This was indicated by lessened swelling and pain in the joint and by greater freedom of movement. An additional twenty-eight patients experienced definite subjective improvement without much objective change. This writer attempts to reconcile the metabolic with the infectious theory of chronic arthritis on the assumption that lack of nutritional balance so breaks down the resistance of the tissues as to permit of easier bacterial invasion.

It is difficult to evaluate properly the diet advised by Pemberton. It has given good results in his hands, but whether the benefits achieved are due to restriction of carbohydrate or to other factors, it is not easy to say. The removal of all possible foci of infection, the reduction of weight, the change perhaps in intestinal flora, improved hygiene—all of these measures are utilized by Pemberton, and each, no doubt, has its influence. If one continues for a long period of time, several months or years, the painstaking clinical management as well as the dietary restriction utilized by Pemberton, he will often benefit the sufferer with chronic arthritis.

The following sample diets were taken from the writings of Pemberton: The first was designed for a frail anemic woman with chronic arthritis; the second for a lieutenant in the army.

A

Breakfast: Toast, 30 Gm. butter, 3 Gm. boiled rice, 25 Gm. (as a cereal); weak coffee, with 1 tablespoonful of cream and 1 teaspoonful of sugar.

Dinner: 1 chop, 70 Gm. (30 Gm. residue of bone), or 35 Gm. of chicken, beefsteak, or fish; butter, 3 Gm. 1 glass of milk, with 2 tablespoonfuls of 20 per cent cream; toast, 30 Gm. raw tomatoes, 3 slices; weak tea, with 1 tablespoonful of cream and 1 teaspoonful of sugar.

Supper: Lettuce, with 1 tablespoonful of French dressing; toast, 15 Gm. butter, 4 Gm. milk (fzvj), 1 glass, with 2 tablespoonfuls of 20 per cent cream; 1 egg (poached); raw tomatoes (2 slices).

B

		Calories
Breakfast:		
1 apple	150 Gm.	72
1 egg	50 Gm.	83
Bread	60 Gm.	162
Butter	15 Gm.	120
Sugar	20 Gm.	80
Milk	60 c.c.	39
Coffee		
Lunch:		
Bouillon	180 c.c.	
Lettuce	40 Gm.	
Mayonnaise	1 tablespoon	187
String beans	100 Gm.	17
Bread	30 Gm.	80
Butter	10 Gm.	80
Orange	250 Gm.	96
1 egg	50 Gm.	83
Supper:		
Steak	50 Gm.	143
Bread	60 Gm.	160
Butter	15 Gm.	120
Tea		
Sugar	20 Gm.	80
Milk	60 c.c.	39
Beets	100 Gm.	40
Lettuce	40 Gm.	
French dressing	2 tablespoons	298
1 apple	150 Gm.	72
Total calories		2,051

The following specimen diets used by the author are somewhat in accordance with those of Pemberton.

ARTHRITIS: SPECIMEN DIET 1

	Protein	Calories	Total
Breakfast:			
½ small grapefruit	1	70	
1 shirred egg with 3 slices crisp bacon	11	235	
1 whole wheat muffin with 1 tsp. butter	4	139	
1 cup coffee with 1 tsp. sugar and 2 tbsp. cream	..	148	
	16	592	592
Dinner:			
Average helping lean roast lamb or beef	23	111	
1 heaping tbsp. mashed or creamed potatoes	2	56	
3 heaping tbsp. buttered carrots	1	18	
Average sized (⅓ solid head) lettuce salad with 2 tsp. French dressing	..	90	
1 small corn muffin or medium sized slice bread	3	80	
Canned pears—2 halves	..	78	
½ tbsp. butter	..	59	
1 glass milk	7	157	
	37	649	649

SUPPER:	Protein	Calories	Total
A. h. minced liver; boil, mince and make sauce with 1 tsp.	20	133	
butter and 1 tsp. flour	..	45	
Mix and serve on 1 a. s. slice toast	2	62	
A. h. beet greens or spinach with ½ hard	5	95	
boiled egg; ½ slice bread or small biscuit	2	50	
Fruit cup (made with ½ m. s. orange and ½ large grapefruit)	4	187	
1 glass milk	7	157	
	40	729	729
Total	93	...	1,970

SPECIMEN DIET 2

BREAKFAST:	Protein	Calories	Total
Fresh pear, pineapple, strawberries or ½ m. s. orange	1	45	
A. h. broiled calves' liver; 1 tsp. butter	20	172	
1 soft boiled egg	6	80	
2 small slices toast	2	62	
1 cup coffee with 2 tsp. sugar and 2 tbsp. cream	..	188	
	29	...	547
DINNER:			
A. h. beef, lamb, fish or m. h. roast turkey or chicken	23	133	
1 h. tbsp. boiled rice	3	112	
A. h. cabbage or cauliflower with 3 tbsp. cream sauce	1	8	
	2	91	
M. tomato salad with lettuce and 1 tsp. mayonnaise	3	85	
Baked banana in skin	1	115	
1 small corn muffin or slice bread	3	80	
1 glass milk	7	157	
	43	...	781
SUPPER:			
1 egg omelet with 3 strips crisp bacon	11	235	
3 h. tbsp. stewed celery; ½ tsp. butter	..	31	
1 M. half-ripe tomato broiled; ½ tsp. butter	3	65	
1 slice pineapple salad on lettuce with 1 tsp. grated cheese and 1 tsp. mayonnaise	..	152	
1 small whole wheat muffin	3	80	
1 glass buttermilk	7	80	
	24	...	643
Total	96	...	1,971

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CHAPTER XXIII

DISEASES OF THE NERVOUS SYSTEM

Nutritional failure is the source of a great deal of nervous disease; not necessarily of recognizable organic disease, but rather of the numberless vague functional disorders which sometimes combine to produce what for want of a better diagnosis is called neurasthenia. Witness the polyneuritis with extensive nerve degeneration leading to complete disability which occurs in a pigeon deprived of vitamin B, and the miraculously rapid recovery which takes place when such a bird is given a few cubic centimeters of washings of bran or other food containing this vitamin. In man the polyneuritis of beriberi presents in like manner striking evidence of the nerve changes which may follow faulty diet. Deficiencies of smaller degree and less clear-cut will also produce nervous disease, to illustrate which McCollom has called attention to the restlessness and irritability seen in rats which have been fed on a diet lacking in protein. Such animals are nervous, restless, vicious and hard to tame, and when taken from the cage are likely to bite. On the other hand, other animals, even from the same litter, which have been properly fed are usually quiet and gentle, and can be picked up and handled without showing undue excitement. We can appropriately apply to man many of the lessons thus learned in animal experiment. Clinical experience shows that neurasthenics, gastro-intestinal invalids and other nervous people are frequently benefited and occasionally cured by a well balanced dietary regimen.

THE PSYCHONEUROSES: THE REST CURE

Dietary regulation with rest and psychotherapy is widely used in the treatment of psychoneurotic patients. Many minutely outlined regimens of this nature have been devised, the original and best known of which is the Wier-Mitchell rest cure. These cures are often of great value, but no single method of treatment can be applied indiscriminately to all patients; the general principles may be adopted, but the details of the treatment should be adjusted to the individual case. Three therapeutic factors should be combined: (1) complete physical and mental relaxation, (2) psychotherapy and (3) adequate nutrition;

they cannot be separated. Before discussing the third, some consideration must be given the first two.

Rest should as a rule be absolute. In the strictest regimen the patient is kept in bed under the care of a special nurse, and is permitted no visitors, no mail and no communication with the outside world except through the physician or nurse. It is understood that should any event of importance occur the patient will be told, but that otherwise he is to have no communication with his family or with any one else. To allay anxiety it is often advisable to permit the nurse to communicate daily with the family in order to assure them that the patient is all right. At first no exertion whatever is permitted. Later, more and more activity is allowed, and toward the end of the rest period the patient is permitted to sit in a chair a while each day. During certain hours of the day it may be advisable to permit the nurse to read aloud from selected literature, but the reading period should never be sufficiently long to be exhausting. The literature should be prescribed by the physician, and should be of such nature as is calculated to have the proper psychic influence.

Psychotherapy, conscious or unconscious, administered by the nurse and physician, forms an important part of this treatment. In fact, Dubois, who has used this type of therapy extensively, has come to the conclusion that psychic influences form the most important feature of the cure. After the patient's confidence has been gained by a thorough painstaking examination, the nature of his malady should be explained to him. He should be told that he is not so very different from the average person, that his troubles are not as big as they appear to him, and that within a reasonable time they will become less burdensome and perhaps even disappear. Confidence, frankness and encouragement are essential. The degree of success of the rest cure is often in direct proportion to the tact of the nurse and the ability of the physician to influence the patient and the amount of time he is willing to devote to it. Further details of the psychic feature of the rest cure cannot be discussed here, but its predominating importance is emphasized. The length of treatment should vary according to the nature and severity of the case; from four to eight weeks in a hospital or nursing home with another six or eight weeks of careful supervision elsewhere is usually necessary.

The dietary regulation of this method of treatment has a threefold object: (1) physiologic rest of the gastro-intestinal tract, (2) the correction of nutritional deficiencies, and (3) the discipline and education of the patient. To accomplish the first, treatment is begun with a very light diet, usually nothing but milk. Later, this is increased until the patient is taking relatively large quantities of ordinary wholesome food. The second object requires that the patient be given not only a well balanced diet which contains all nutritive essentials, but in many instances a sufficient excess to make up for previous chronic starvation. For the attainment of the third objective, patience, persistence and firmness are often demanded. The folly of many of his dietary phobias must be explained to the patient, and he should be required to eat the foods which are good for him but which he possibly does not like; he should be taught the type of diet which is best suited to the maintenance of health.

In the beginning nothing but milk, say 6 ounces of cold milk every two hours from 7 a. m. to 9 p. m., should be given. Milk should be insisted on in spite of all possible objections. Before agreeing to its omission, the physician must satisfy himself that the patient is actually sensitive to milk proteins or that for other good reasons he cannot take this valuable food; such people are extremely rare, possibly two in a thousand. The reasons for thus insisting on milk are: (1) that it is an excellent article of food which every patient should learn to take; (2) that its use for a time will rest the stomach and intestines, and (3) that for those who are afflicted with phobias and notions, discipline in the very beginning is essential. Patients with vascular hypertension and those with threatened myocardial disease are often materially benefited by the milk diet. This should be continued for from four to seven days, at the end of which time other foods may be added. This additional food may be permitted gradually; or—and I have found this to work well—it may without warning be given as a full, well balanced meal which the patient is told that he must eat. Usually he is by this time hungry and will take the full diet gladly. The diet which follows should be distinctly individual and should depend on the patient's needs and in a measure on his tastes.

For the purposes of dietary regulation, two types of psychoneurotic patients are roughly recognized: (1) the thin, undernourished anemic person and (2) the over-fed, ruddy person, often with arteriosclerosis and arterial hypertension. Patients of the first group require an abundance of good food and should as a rule be subjected to forced feeding. Three full meals daily should be given, in which are included two helpings of meat and an abundance of fruits and green vegetables. Milk with the meals and between meals, and perhaps raw eggs after meals, should be given. Because of its blood-building qualities, liver as well as muscle meats should be included. Everything should be done to stimulate the appetite; the food should be nicely prepared and appetizing, and it should be arranged on an attractive tray.

The other type of patient should have a well balanced diet which meets but does not exceed his actual caloric needs. Emphasis should not be laid on any one particular food. Unless there is pronounced renal impairment, meat should not be excluded but should be permitted in moderation. An abundance of green vegetables and fruits are desirable. Below are given sample menus suitable for the two types of patients under consideration. Each regimen must be proceded by the milk diet outlined above.

REST CURE DIETS AND DAY'S SCHEDULE FOR UNDERNOURISHED PATIENTS

I.

		Calories
6:30	Orange juice	
7:00	Warm sponge or tub bath	
8:00–8:30	BREAKFAST:	
	Strawberries peach or small orange	
	2 heaping tbsp. oatmeal with 2 tsp. sugar and 2 tbsp. cream	
	1 egg omelet	
	1 plain muffin with 1 tsp. butter and 1 tbsp. honey	
	1 glass milk	806
9:30–10:30	Light massage	
10:30	2 glasses milk	314
	Complete rest for two hours.	
1–2	DINNER:	
	4 tbsp. cream of tomato soup with 2 saltines	
	Average helping kidney stew	
	Average sized baked potato with 1 tsp. butter	
	2 heeping tbsp. lima beans	
	Medium sized tomato and lettuce salad with ½ tbsp. mayonnaise	
	2 corn muffins or 2 slices whole wheat bread	
	1 tbsp. butter	
	Prune souffle made with ½ cup stewed and seeded prunes and 1 egg white	
	1 glass milk	1,183
2–4	Rest and sleep	
4:00	2 glasses milk and 1 egg with 2 tsp. sugar, flavored and made into milk shake	477
5:30–6:30	SUPPER:	
	Creamed chicken giblets en casserole	
	2 heaping tbsp. spinach	
	Small lettuce salad with French dressing, 2 tsp.	
	1 whole wheat muffin and ½ tbsp. butter	
	2 h. tbsp. chocolate pudding	
	1 glass milk	923
8:30–9:30	Light massage with alcohol rub	
9:30	1 glass milk, 1 egg, 1 tsp. sugar	280
	Total	3,983

II.

		Calories
6 a. m.	Glass orange juice	
7 a. m.	Warm tub bath or sponge	
8 a. m.	BREAKFAST:	
	Large baked apple with 2 tbsp. cream	
	4 h. tbsp. oatmeal with 2 tsp. sugar and 2 tbsp. cream	
	Soft boiled egg	
	1 whole wheat muffin with 1 tsp. butter	
	1 cup cocoa	1,062
10–10:30	Light massage to entire body	
10:30	Egg milk shake (⅔ gl. milk; 2 tsp. sugar; 1 egg)	267
10:30–11:30	Rest-sleep	
1 p. m.	DINNER:	
	A. h. roast beef	
	2 h. tbsp. mashed potatoes	
	2 h. tbsp. spinach with 1 hard boiled egg	
	Small lettuce salad with 1 tbsp. Thousand Island dressing	
	1 corn muffin or 1 slice whole wheat bread	
	2 h. tbsp. ice-cream	
	⅔ glass milk with 4 tbsp. cream	
	1 tbsp. butter for seasoning, etc	1,231
2–4 p. m.	Complete rest and quiet	
4 p. m.	2 glasses milk	314
5:30 or 6	SUPPER:	
	A. h. broiled liver with sauce made with 1 tsp. butter and 1 tsp. flour	
	Asparagus, buttered (5 stalks) on toast (small); tbsp. butter	
	Peach and pear salad on lettuce with ½ tbsp. mayonnaise	
	1 muffin or slice of bread; ½ tbsp. butter	
	2 h. tbsp. rice pudding	
	⅔ glass milk with 2 tbsp. cream	925
8:00 p. m.	Light soothing massage ½–1 hour	
	Alcohol rub	
9:00 p. m.	1 large glass hot milk	235
Total		4,084

III.

		Calories
6 a. m.	½ m. s. orange	48
7–7:30	Warm tub or sponge; alcohol rub	
8–8:30	BREAKFAST:	
	4 large prunes with juice	
	1 h. tbsp. grapenuts with 1 tsp. sugar and 2 tbsp. cream	
	A. h. creamed chicken livers on toast (boil, mince), mix with 3 tbsp. cream sauce (use liquid)	
	1 cup coffee with 2 tsp. sugar and 2 tbsp. cream	880
9:30–10:30	Light massage	
10:30	2 glasses milk	314
	Rest-sleep one hour or longer	
1–2 p. m.	DINNER:	
	one lamb chop	
	Served with 1 m. s. half-ripe tomato broiled	
	1 m. s. baked potato; butter 1 tsp.	
	3 heaping tbsp. creamed carrots, 2 whole wheat muffins	
	3 small stalks celery; 3 large olives	
	2 h. tbsp. Spanish cream with 1 tbsp. whipped cream	
	1 glass milk; ½ tbsp. butter	1,237
2–4 p. m.	Quiet and complete rest	
4 p. m.	2 glasses milk; 1 egg, 2 tsp. sugar made into milk shake	477
5:30–6:30	SUPPER:	
	1 egg souffle (1 tsp. butter—make like fluffy omelet and bake in oven)	
	2 tbsp. creamed potatoes	
	2 heaping tbsp. string beans	
	½ peach on lettuce as salad with cream dressing	
	1 whole wheat muffin; ½ tbsp. butter	
	2 heaping tbsp. chocolate custard made with 1 cup milk, 1 egg, 1 heaping tsp. chocolate, 1 heaping tbsp. sugar	886
8:30 p. m.	Thorough massage to entire body and alcohol rub ½ to 1 hour	
9:30 p. m.	Glass hot milk	157
	Total	3,999

REST CURE DIETS FOR PATIENTS WHO ARE WELL NOURISHED

I.

		Protein	Calories
6:30	Cup hot water with juice of ½ lemon and 5 dried dates	..	133
7–7:30	Good warm bath		
8 8:30	Breakfast:		
	½ small grapefruit	1	
	1 a. s. slice toast with 1 tsp. butter	2	
	Cup coffee with 1 tsp. sugar and 1 tbsp. cream	1	
			268
10–11	Entire body massage with Swedish movements, very light for first 3 or 4 days		
11:00	2 glasses milk	14	314
	Complete rest for 1 hour		
1–2	Dinner:		
	Fruit cup (½ each orange and grapefruit)		
	Small serving (1 slice) roast lamb, lean	15	
	2 tbsp. beet greens or spinach	2	
	M. s. tomato salad with vinegar—2 large olives		
	1 corn muffin with 1 tsp. butter		
	2 h. tbsp. apple tapioca		
	1 glass milk	7	
			622
2–4	Rest		
		42	1,337
4:00	Exercise in bed ½ hour		
4:30	1 glass milk	7	157
5:30–6:30	Supper:		
	1 shirred egg	6	
	5 stalks asparagus on small slice toast; ½ tsp. butter	3	
	1 tbsp. steamed cabbage	1	
	M. s. tomato and lettuce salad with vinegar		
	3 small stalks celery	1	
	1 bran muffin with 1 tsp. butter	2	
	2 h. tbsp. orange ice	1	
	1 glass milk	7	
			721
8:30–9:30	Heavy (after several days) massage and alcohol rub		
9:30	1 glass milk, hot	7	157
	Total	77	2,372

II.

		Protein	Calories
6:30 a. m.	Cup hot water with juice of ½ lemon and 4 dried figs	4	252
7:00	Warm tub or sponge bath with alcohol rub		
8–8:30	BREAKFAST:		
	½ cantaloupe or 1 medium orange	2	
	2 small bran muffins with 1 tsp. butter	4	
	1 sauce dish of stewed tomatoes		
	1 cup coffee with 1 tsp. sugar and 2 tbsp. cream	2	
		12	403
9–10	Heavy (after few days) massage and Swedish movements and alcohol rub		
10:30	1 glass milk	7	157
	Complete rest for one hour		
1–2	DINNER:		
	Small serving nonfat fish	11	
	Small baked potato	2	
	2 h. tbsp. new young string beans		
	2 h. tbsp. squash	1	
	A. h. vegetable salad (cucumber, onion on lettuce with vinegar)	1	
	1 corn muffin or average sized slice bread	2	
	1 heaping tbsp. lemon ice		
	1 glass milk	7	
		31	611
2–4	Complete rest		
4–4:30	Exercise in bed		
4:30	1 glass milk and 2 graham crackers	7	157
		2	68
5:30–6:30	SUPPER:		
	1 egg scrambled with 2 tbsp. tomatoes	6	
	3 heaping tbsp. stewed celery	1	
	Average helping baked egg plant	1	
	½ head lettuce salad with vinegar	1	
	1 slice whole wheat bread with 1 tsp. butter	3	
	1 cup custard		
	1 glass milk	7	537
8:30–9:30	Heavy massage with alcohol rub		
9:30	1 cup hot milk with 2 Uneeda biscuits	3	50
		31	812
	Total	74	2,235

Anorexia Nervosa.—Lack of appetite, amounting at times to actual repugnance toward food, may in nervous patients be so persistent as actually to endanger life. It is often very difficult to overcome. Isolation, complete rest, physical and mental, psychotherapy and the type of dietary regulation outlined above, all taken together, are often of benefit. Psychic influences predominate in the etiology of this trouble, and therefore carefully applied psychotherapy with patience and great firmness is necessary to overcome it. It may be necessary to use the stomach tube for forced feeding. Persistence through many months, even from six to eighteen, may be necessary.

Migraine.—The type of headache which we know as migraine, or sick headache, is probably a vasomotor neurosis which occurs in persons with an underlying constitutional predisposition. Heredity is the only causative factor of which there is any definite knowledge. The patient's family history practically always tells of headaches in parents and other relatives. While there is no other single etiologic factor of importance, it can be said that any physical or psychic disturbance, however trivial, may precipitate an attack in predisposed persons. In one it may be eye-strain; in another, worry or excitement, the menstrual upset, constipation or perhaps some gastro-intestinal trouble. Because nausea and vomiting are frequent accompaniments of the attack, the belief becomes firmly fixed in many of these patients that some error in diet is the responsible factor. It is necessary to combat this error. In spite of the prominent place which gastro-intestinal disturbance occupies among the symptoms, it seldom bears any etiologic relation to the disease.

It is necessary to make a careful examination of the patient, and, since anaphylaxis is believed by some to be a factor in the production of migraine, it is well to test the patient for protein sensitization. If he is found to be sensitive to any particular food, this should be excluded from the diet. It is only in the rarest instances, however, that anaphylaxis forms the real basis of the trouble.

Patients with migraine should always be warned against one-sided diets, which are usually chosen through prejudice. Great caution should be observed in assuming that any one food or group of foods is responsible. There is no dietary formula which is peculiarly suited to migraine. Idiosyncrasies should be considered, dietary errors corrected, and the patient then given a full, well balanced diet in which is included an abundance of milk and green vegetables.

Psychic influences sometimes play a rôle in the production of migraine, and when present they should be combated.

The Epilepsies.—Epilepsy represents a clinical but not an etiologic entity. Although probably due always to some disturbance of the brain, the nature of these disturbances may be manifold. Before attempting to regulate the diet of an epileptic person, it is necessary that the true nature of his disease be recognized. Distinction should be clearly made between epilepsy on the one hand, and the convulsive seizures of hysteria, paresis, lead poisoning, uremia and chronic alcohol on the other.

No metabolic disturbance can be said to be characteristic of epilepsy unless, as has been suggested, there is a disturbance in calcium metabolism. Epileptic patients are believed to be greatly benefited at times by the administration of calcium, and for this reason it is advisable to give foods, such as milk, which are rich in this element.

Fasting as a therapeutic measure in epilepsy was first prescribed by Guelpa; recently it has been extensively used by an osteopathic practitioner, who has claimed for it highly beneficial results. No food is given for a number of days, and there follows a ketosis, to which the merit of this treatment, if there be any, is credited. More recently the same thing has been accomplished by a diet poor in carbohydrate and protein and high in fat—the so-called ketogenic diet. Among the more favorable reports which have appeared is one from Peterman,[1] of the Mayo Clinic, who writes: 'The results from treatment have been very encouraging. Of the thirty-seven patients treated, nineteen are now entirely free from attacks." On the other hand, Weeks[2] and his associates have seen no benefit from such a diet. They conclude:

> The therapeutic value of fasting was tried in epileptic patients for three weeks. Epileptic seizures ceased during the fast in only 30 out of 64 instances, but in general the observations confirm those of previous writers that the attacks are more or less diminished during this time. We have interpreted this result as an accidental phenomenon, such as can easily be produced in epileptics by a variety of psychic and other influences, and not as a genuine therapeutic benefit . . . These diet tests have afforded no indication of a metabolic element in epilepsy. On the practical side, the most important conclusion is that any kind of healthful mixed diets may be used in the management of epilepsy.

The ketogenic diet used by the proponents of this form of therapy is merely one which contains a small amount of protein, an extremely small amount of carbohydrate and a very large amount of fat. The protein must be enough to meet the patient's minimal daily nitrogen need, say for an adult, 0.75 Gm. per kilogram and for a child from 1 to 2 Gm. per kilogram, and sufficient fat to produce marked ketosis. To accomplish this, large amounts of butter, cream and olive oil must be given.

The tendency of many epileptic patients to improve for a time after any new treatment is instituted makes judgment as to the value of this procedure difficult. The consensus of opinion among conservative clinicians seems to be that this treatment is without permanent therapeutic value.

There is apparently no one type of diet suitable for all epileptic patients. Each patient must be carefully examined, his dietary habits of the past analyzed, and a simple, easily digested, well balanced diet tentatively prescribed. Occasionally it is found that the attacks are less frequent when certain articles, such as meat for instance, are eliminated. The physician should be guided largely by experiment with the individual patient rather than by generalization. It should be added, however, that the beneficial influence of a lactovegetarian diet seems fairly well founded on experience. It is never wise to eliminate meat entirely without good reason, but there are many patients who have fewer attacks and as a rule do well on the type of lactovegetarian diet given on page 406.

The physician should see to it always that the diet provides all essentials, and that the patient is not permitted to suffer from any form of dietary deficiency. In addition, certain general rules as to eating should be insisted on. The meals should be regular, and if possible should be taken slowly when the patient is not in a hurry. As a rule, the lightest meal should be taken in the evening.

DISEASES OF THE SPINAL CORD

Tabes Dorsalis.—The type of diet suited to the patient with this disease depends entirely on the extent of his disability. As a rule, a simple, well balanced wholesome diet such as has been advised for the normal person is suitable. In the more advanced stages it is often advisable to give the patient frequent feedings, say five meals daily, and to restrict him to the simpler, more easily digested foods. In restricting the food, however, care should be taken to see that he gets enough nourishment and that all essential elements are included. The constipation which frequently accompanies this disease can in a measure be prevented by an abundance of vegetables and fruits. It is not necessary to interdict coffee, tea, and alcohol altogether, but these should be taken sparingly. It is sometimes necessary to combat phobias which the patient may have concerning the harmful effect of certain articles of diet, such for instance, as meat.

What has been said above of tabes dorsalis applies also to other manifestations of syphilis of the cord, to Friedreich's ataxia and to acute and chronic myelitis. The necessity for preserving the patient's strength applies with equal force in these diseases as in other forms of acute and chronic illness.

Chronic Progressive Bulbar Palsy.—This condition requires special comment because of the necessity for permitting the affected muscles, particularly those of deglutition, as much rest as possible, while at the same time the patient's nutrition is preserved at the highest possible level. Difficulty in swallowing intensifies the problem. Milk in any form, eggs, raw or soft-boiled, cereals with cream, and other highly nutritious foods in a liquid or semisolid state should be given. Meat, when permitted, should be thoroughly ground and preferably given in the form of a puree. Carbohydrates should be largely in the form of gruels, as these are swallowed more easily than dry bread. Some of these patients swallow semisolid food better than liquids. Later in the illness, when the patient can no longer swallow, he should be nourished through the stomach tube, but this method of feeding should be postponed as long as possible. A little coffee once daily may be permitted, but as a rule caffeine-containing drinks and alcohol are undesirable.

Combined Sclerosis.—Combined sclerosis of the cord usually occurs in patients who are anemic and of low vitality. Just what relation the anemia bears to the disease of the cord is hard to say, but unquestionably factors which combat the anemia will often retard or even altogether stop the progress of the nerve degeneration. For this reason it is advisable to give these patients a diet which is rich in good protein, especially muscle meats and liver. This type of diet is outlined in the chapter on secondary anemia. The cord changes seen in pernicious anemia require, of course, the type of diet suitable for that disease. This will be found on page 635.

Neuritis.—Whether multiple or single, neuritis is often due to some constitutional disturbance. The suitable diet therefore is the one which should properly be given for the underlying disease. The possibility of gout and diabetes should be borne in mind. The fact that vitamin deficiency when carried to an extreme degree results in nerve degeneration should not be lost sight of in the treatment of neuritis, for it is not beyond the range of possibility that mild degrees of chronic vitamin deficiency can cause this type of disease. For this reason the patient's dietary habits should be carefully studied for evidences of deficiency in vitamin or mineral content. If such deficiencies are found, they should be corrected and the patient given a full, well balanced diet in which milk and the leafy portion of green vegetables form an important part. What has just been said of neuritis in general applies, of course, to that particular form known as sciatica.

Neuralgias.—Neuralgia is likely to appear in patients whose vitality is low. Many of these are sufferers from chronic nutritional failure, and for this reason they are sometimes benefited by a full well balanced diet in which is included an abundance of protein, the leafy portion of vegetables, milk and cream and perhaps cod liver oil.

Diseases of the Brain.—Such diseases as cerebral hemorrhage, thrombosis, tumor, abscess and syphilis are not influenced by any particular type of diet. The extent of the patient's debility should determine the kind and quantity of food and the frequency of the feedings.

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CHAPTER XXIV

DISEASES OF THE SKIN AND OF THE ENDOCRINE ORGANS

SKIN DISEASES

The dietary instructions given the patient with skin disease are, as a rule, based on tradition rather than on reason. In no part of the science of nutrition is there today greater need for rationalism. When we read in the older textbooks that ringworm of the scalp can be cured through the omission of certain foods and that sycosis is due to too much meat, and then today hear statements of the beneficial influence of special diets in eczema, psoriasis, acne rosacea and other skin diseases, statements which are based on little better experimental and clinical evidence than those of the older writers, we begin to suspect that many of the latter day views may perhaps miss the mark by just as wide a margin as did those of a generation ago. If we did not understand so well the nature and treatment of impetigo contagiosa and of syphilitic roseola, I suspect that these also would be subjected to attempted dietary regulation. In this field of therapy opinion has been molded by a small amount of fact and a world of fancy.

The facts at our disposal are these: Anaphylaxis is accompanied by urticaria and other skin manifestations; diabetes, and possibly gout, are occasionally complicated by dermatitis; pellagra and other deficiency diseases are accompanied by dermatoses; and digestive disorders, without regard to any particular food or type of diet, may be accompanied by erethema and other related skin manifestations. Beyond this there is serious question as to whether any skin disease is produced or made worse by any particular food. It is sufficient in the vast majority of skin diseases to prescribe wholesome regular habits with a simple well balanced diet, such a diet as will best promote the person's general health.

Following this diatribe against traditional views, it seems best that some brief discussion be given of certain recently expressed opinions based largely on clinical investigation.

Eczema.—Eczema is usually the manifestation of a hitherto latent dermal susceptibility. It may be produced by the widest variety of irritants, both internal and external. The belief that it represents at times a disturbance of carbohydrate metabolism has, in the opinion of many dermatologists, the support of clinical experience. McGlasson,[1] in his recent studies on blood sugar, found that there are selected dermatoses of toxic character in which hyperglycemia is a salient feature, and he concluded that carbohydrate restriction, particularly in the eczema of infants, is of definite value. The weight of this evidence, however, is lessened by our lack of knowledge as to what actually constitutes hyperglycemia; many of this writer's figures fall well within the normal blood sugar limits. Schamberg, in discussing McGlasson's paper, stated that in his own investigations he did not find any marked deviation from the normal blood sugar in 500 cases of dermatoses among adults. Viewing this subject purely in the light of clinical experience, many dermatologists feel that there is sound reason for restricting carbohydrates in eczema. On the other hand, there are just as many, among which are included Haldane-Davis and other English writers, who have been unable to see any benefit whatever in carbohydrate restriction.

Another view of the relation of diet to eczema is taken by Schamberg and Brown,[2] who found excessive uric acid values in the blood of patients with eczema and dermatitis. Forty-four per cent of their patients showed hyperuricacidemia, which led them to state that "an excess of uric acid in the blood unaccompanied by a rise in the other nitrogenous constituents is far more common in the patients with eczema and dermatitis than among patients ill of various diseases." They gave their patients a purin-poor diet, such a diet as is advised for gout, and reported unusually satisfactory results. Diametrically opposed to this is the opinion of Michael,[3] whose studies on normal persons and patients with eczema led him to conclude that a disturbance of purin metabolism does not play a rôle in this disease. This worker found that uric acid, urea and creatinin are not dermal irritants, and he expressed the opinion that the improvement in eczema which may sometimes accompany a purin-free diet can be construed in other ways than by its influence on the uric acid of the blood. From similar investigations, Michael and Nicholas[4] write: "Thus we conclude from the data obtained from these patients with eczema that they differ in no essential way from the results in normal persons recorded by other investigators." One is tempted to conclude that perhaps after all the patient with eczema requires merely a wholesome, well balanced diet, and that rigid restriction of any kind, whether it be of carbohydrate or protein, is unnecessary.

Psoriasis.—This disease has been attributed to nitrogen retention, and it is believed by some dermatologists, notably by Schamberg,[5] that a low protein diet is of benefit. This author expresses the opinion that severe psoriasis is accompanied by a profound state of protein undernutrition due to the fact that the scales which are being constantly exfoliated consist of pure protein. He believes that the benefit achieved by a nitrogen-poor diet in psoriasis is due to the fact that the small amounts of protein thus eaten are utilized solely for normal wear and tear, and that none is left for the manufacture of cutaneous scales, a view which fails to accord with our general knowledge of protein metabolism. And, too, if it were possible to weigh for a day all the scales from a patient with severe psoriasis, it is doubtful that they would be found to represent more than a gram of protein. The belief that patients with psoriasis are benefited by a low protein diet does not appear to be well founded; for a critical survey of clinical experience would lead one today to conclude that diet is without influence on the course of the disease.

Acne Rosacea.—This is due to an abnormal flushing of the face, which is dependent in turn on vasomotor instability. Alcohol will produce it, and it is possible that hot drinks, particularly tea and coffee, will do the same. Clinical experience would indicate that this disease may come also from gastro-intestinal disturbances of almost any nature, but not necessarily from any particular food. Highly seasoned foods may so upset the stomach as to lead reflexly to circulatory disturbance in the skin, and the same may be said of fried foods, rich desserts and condiments. The diet suitable for this disease, then, is obviously a simple one which includes no fried or very greasy foods, no condiments or highly seasoned dishes and no tea or coffee or other hot drinks. It should consist largely of milk, cereals with cream, eggs and other easily digested nutritious foods.

Acne Vulgaris.—This eruption can perhaps be attributed to the same type of dietary indiscretion which is believed to contribute to acne rosacea. Gross violations of hygiene, and particularly irregularity in the time of eating, are believed to be responsible. A rational diet such as is outlined above for acne rosacea is suitable.

Erythema.—Erythema multiforme is probably due to several different toxins. Some of the so-called erythemas may represent a manifestation of anaphylaxis, others may result from toxins generated in the intestinal tract, while still others are due to unknown causes and physical agents. No particular type of food beyond the normal rational diet is demanded. When the experience of the patient indicates with reasonable certainty that a particular food, shell fish for instance, produces erythema, then that food should be eliminated from the menu. The danger here is that imagination may get the best of both patient and physician and lead to the unnecessary elimination of many valuable foods.

Dermatitis.—Dermatitis represents merely an inflammation of the skin which can be due to the widest variety of causes, internal or external. No single dietary regimen is invariably suitable. From a nutritional standpoint, the only thing of value is to be sure that the patient has not diabetes. A simple well balanced diet is advisable. It is said that the patient with dermatitis should avoid alcohol, tea, coffee and tobacco. The same can be said of any other disease.

DISEASES OF THE ENDOCRINE ORGANS

Addison's Disease.—This disease is often accompanied by a deficiency in gastric juice, which demands not merely the administration of hydrochloric acid by mouth, but some care in the choice of food. Diarrhea may become an exceedingly distressing symptom; I have known a patient with Addison's disease to die during the gastro-intestinal upset which followed gross indiscretions in diet. For this reason it is advisable that the patient be limited to such simple articles of diet as milk, cereals with cream, soft boiled or poached eggs, toast with butter, tender meats and any of the simpler desserts, such as rice or tapioca pudding.

The great prostration which accompanies not only true Addison's disease, but also those vague states of weakness which may be related to this disease, can to a small extent be combated by a highly nutritious wholesome diet. The stimulating effect of protein often adds to the patient's comfort. He should be given meat at least once daily, two eggs and a liberal quantity of milk. When vomiting or diarrhea become severe, it may be necessary to withhold all food for a time.

Simple Goiter.—This has been discussed among the deficiency diseases.

Exophthalmic Goiter.—This type of goiter is accompanied by such a rapid metabolic rate that in order to prevent the destruction of his own tissues, the patient should be given an amount of food which under other circumstances would be regarded as excessive. The diet should be a well balanced one such as any normal person should eat, but its total caloric value should be increased in accordance with the elevation of the metabolic rate. A patient whose metabolic rate is 150 per cent of the normal should increase his caloric intake 50 per cent or more. Boothby[6] believes that to meet the patient's nutritive needs 75 per cent or more should be added to the basal metabolic requirement and DuBois,[7] in quoting the calculations of Sturgis, reached a similar figure, 84 per cent.

The effort should be to preserve nitrogen equilibrium, and to this end the protein quota of the diet should be emphasized. It is believed by some that intestinal putrefaction plays a prominent rôle in this disease, and the suggestion has been made that all meats be eliminated from the diet; this is not in accordance with present day clinical experience. Patients with exophthalmic goiter should eat an abundance of good protein in which is included a fairly liberal quantity of meat.

Milk, cereals with cream, fruits and green vegetables should form an important part of the diet. Patients with goiter have a lowered tolerance for glucose, and for this reason they should not be given too much sugar; when there is glycosuria, the carbohydrate quota of the diet should be reduced somewhat.

Vomiting and diarrhea may become distressing, in which case the diet should be restricted to the simplest foods, such as milk and cereals. Care should be taken, however, that food restriction is not carried too far.

These patients can be much more satisfactorily nourished if at rest in bed. Absolute rest is essential in the severer cases. The type of treatment which has been outlined for the rest cure of nervous patients, with full emphasis on the personality of physician and nurse and its influence on the patient's morale, is appropriate here also.

Myxedema.—This condition is not amenable to dietary regulation; indeed, patients with this disease are sometimes made much worse by mistaken dietary restriction. The increased weight of myxedema patients is not due to overeating and cannot be corrected by a restricted intake. Borderline myxedema and obesity should be clearly distinguished; the rigid curtailment of food necessary for the latter should not be advised for the former.

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CHAPTER XXV

THE FEEDING OF SURGICAL PATIENTS

By Barney Brooks, M. D.

Vanderbilt University, Nashville

It is well at the outset to emphasize that this chapter deals only with the matter of nutrition so far as it is related to conditions universally accepted as purely surgical in nature. It is worth while calling attention to the fact that the period of application of purely surgical procedures is much too short for the institution of changes of feeding meant to be more or less permanent. Eating and drinking are quite as much a part of an individual's personality as clothes and cleanliness, and it is too much to hope to be able to institute changes in lifelong habits in so short a period as that which is usually immediately associated with purely surgical therapeutic methods. It is obvious that patients requiring surgical treatment may be affected by other maladies which must be taken into consideration in every individual case. It often happens that a patient with severe diabetes or nephritis may develop another disease purely surgical in nature, and require surgical treatment. In such an instance the proper administration of food must be determined by a consideration of principles applicable to more than one condition, and the indications for a particular article of nutrition may be absolutely contradictory. The article of nutrition in question must be given or withheld according to the relative severity of the relatively opposite needs. It is also apparent that some patients have diseases which require surgical intervention and a long or permanent remote postoperative dietary regimen. This regimen may be even more important than the surgical operation as, for example, in such a condition as ulceration of the stomach or duodenum. It is not my purpose to deal with the nutrition of patients suffering from a combination of diseases nor to discuss the proper dietary regimens indicated during periods remote from surgical operations.

In general, it may be said that all patients requiring surgical therapeutic procedures need the maximum of food and fluids. In a group of patients in which there is either potential or active infection in the peritoneal cavity, the need of nourishment is not less, but the ill effects of its administration may at times more than offset the ill effects of its omission. It would seem, therefore, as if the feeding of surgical patients might well be considered under two heads: (1) the principles underlying the proper nutrition of all patients requiring surgical therapeutics, and (2) the principles underlying the necessity of restricting foods in patients having potential or active infection of the peritoneum, which obviously includes all patients undergoing abdominal operations.

I. DIET OF PATIENTS BEFORE AND AFTER OPERATION

Every patient who undergoes a surgical operation must pass through a period of serious disturbance in nutrition. The mere contemplation of the necessity of an operation may markedly disturb the patient's appetite for both food and water. His admission to the hospital puts him in a new environment and subjects him to the necessity of taking nourishment in a manner entirely different from his previous custom. The possible ill effect of this radical change in environment is made manifest by the fact that a great many well persons suffer considerable nutritional disturbance from "visiting." The succession of events constituting the actual surgical operation are such as to influence seriously the general nutrition. There is an absence of food beginning even before the operation and continuing at least during the period of nausea and vomiting. The administration of an anesthetic is almost universally attended by a considerable loss of body fluid, together with a considerable upset in the normal mechanism of nutrition. The anesthetic itself should be considered as the administration of a drug with toxic properties, and it has been definitely shown that the toxicity of an anesthetic is distinctly increased in persons with an inadequate carbohydrate reserve. Every operation is attended with loss of blood and followed by a wound which is the source of more or less pain and discomfort. It is, therefore, apparent that any one who is operated on must have a considerable amount of disturbance in nutrition. It is remarkable how often this condition is not anticipated. It much more frequently happens that the surgeon, instead of carrying out measures in anticipation, waits until the condition is apparent and then institutes curative measures. For example, some surgeons administer glucose in some form as a routine postoperative procedure entirely unappreciative of the fact that the glucose could have been much more successfully administered before operation. The same thing might be said of fluids. Fortunately, surgeons are rather generally getting away from the old idea that patients who are to undergo operation must be thoroughly purged, thus producing further grave loss of fluids.

The most important principle to keep in mind in the feeding of surgical patients, therefore, is that every possible means should be employed to preserve or actually increase the state of nutrition immediately preceding a surgical procedure. Patients on whom operations are to be performed should, therefore, be given additional food and fluid as nearly as possible up to the time of operation. The particular articles of food which should be given in abundance are carbohydrates and water. One of the best preoperative preparations which the patient can have is a pitcher of water and a box of candy.

As to the time elapsing between the cessation of taking food or water by mouth and the beginning of the operation, the most important consideration is the amount of food or fluid which the stomach actually contains at the time the administration of the anesthetic is begun. The normal stomach is usually empty five hours after the ingestion of food. There is, therefore, no reason for withholding food for a period longer than twelve hours before operation if the stomach empties itself in almost normal time. Fluids, particularly water, may be given even until two or three hours before operation. When the stomach does not empty in normal time as, for example, in such a condition as pyloric obstruction, it is much better to keep up the administration of food and fluids until not more than twelve hours previous to operation and to remove whatever the stomach may contain with a stomach tube just before the administration of the anesthetic is begun. As for the character of the food given during the period in which an operation is contemplated, there is no necessity to restrict the patient to any food or fluid which is not universally accepted as good nourishing food easily digested without leaving a large residue.

The patient who is being prepared for the usual surgical operation, therefore, requires no restriction of food or fluids. The usual supper may be given the evening before an operation contemplated in the morning, or breakfast may be given if the operation is planned for the afternoon. If the patient is already in a state of poor nutrition, or if it can be foreseen that the nature of the operation will result in prolonged abstinence from food, increased feeding of carbohydrates, especially sugars, is indicated as preoperative preparation.

There can be no routine postoperative diet; such a postoperative routine is used too much. After operation patients are likely to be put through a stage of broth, albumins, fruit juices and such food preparations as are often distasteful to them. This practice often prolongs the period of nausea and vomiting. In general, it may be said that when the time comes for the patient to take food, he is usually able to take any good, wholesome, well cooked food preparation which appeals to his appetite. After any operation other than a gastro-intestinal operation, the patient should be given as nearly as possible the same diet he received before operation, at the earliest time at which he will take it. If the patient is not inclined to take food during the first twenty-four hours after the operation, it is usually best to give him nothing but water until he is willing to take at least a soft diet. Forcing unpalatable liquids during a period of nausea and vomiting often defeats the purpose for which they were intended. It is usually possible to supply ample body fluid by giving water by rectum or salt solution subcutaneously.

II. DIET IN ABDOMINAL OPERATIONS

In surgical patients with active infection of the peritoneal cavity or in all abdominal operations in which there is possibility of contaminating the peritoneum, the importance of withholding food and fluids by mouth for the purpose of preventing intestinal peristalsis outweighs the importance of supplying nutrition. It is perhaps better for all patients undergoing an abdominal operation not to receive food or fluids by mouth for a period of from twenty-four to forty-eight hours following operation. It is perhaps desirable not to give any food or fluid by mouth for a period of a week or ten days to patients with extensive infection of the peritoneum who were well nourished at the beginning of the disease. During the period in which nothing is given by mouth, whether this period is short or long, abundant body fluid must be supplied by hypodermoclysis and proctoclysis. Patients who show the manifestations of severe lack of adequate carbohydrates should receive glucose intravenously.

After any abdominal operation the time at which it is proper to begin the administration of food is perhaps more important than the character of the food given. In general, the indications for withholding food or fluids by mouth are those on which is based a conclusion as to the state of the peritoneal cavity as regards infection. In the usual simple abdominal operation, as, for example, the removal of the appendix or gallbladder, the patient may be given food or fluids by mouth in from thirty-six to forty-eight hours after operation if examination of the abdomen reveals no signs of peritoneal irritation and if the pulse rate has progressively decreased since the time of operation. Those who continue to show an increased pulse rate, increased abdominal tenderness or continued nausea and vomiting should not be given food and fluids by mouth. After abdominal operations on patients in whom there is an existing infection of the peritoneum or in whom there is more or less contamination of the peritoneum during the operation, food and fluids by mouth are usually best withheld for even a longer period than from thirty-six to forty-eight hours. In these patients the manifestations of spreading infection in the peritoneal cavity are the best means of determining the time of the beginning of the administration of nourishment. When the clinical manifestations are such as to indicate no considerable infection of the peritoneal cavity or that existing infection has become safely localized, fluids may be given. It is always best to begin with water given frequently in small amounts. If the patient is given water for a period of from eight to twelve hours and there is no evidence of increasing peritonitis, then fluids containing food substances may be added in the form of broth, albumin water or fruit juices. If such food-containing fluids are not well borne, it is often best to discontinue them and give the patient only water until such time as he is able to take soft solid foods. After the patient is able to take a soft diet, it is always safer to restrict him to such foods as are universally recognized as nourishing and easily digested until he has completely recovered from the operative procedure, that is, for a period of at least three weeks.

PART III

TABLES AND CHARTS OF A GENERAL NATURE

TABLES AND CHARTS OF A GENERAL NATURE

SPECIAL METHODS OF FEEDING

Special methods of feeding are sometimes useful during a critical period, but they seldom suffice long as the only method of nourishment. They may save life, but they should be looked on always as a temporary makeshift.

Gavage.—Feeding through a tube introduced into the stomach may be used when there is difficulty in swallowing, or when for other reasons the patient is unable to eat or refuses to take food. The stomach tube passed in the usual manner or a small tube passed through the nose may be used. The latter method is usually preferable if this form of feeding is to be continued long.

Nasal Feeding.—The small duodenal tube carrying a long wire stylet is passed through the nose and pharynx until the mark on the tube indicates that it has reached the stomach. The stylet is withdrawn, and if the tube is to remain in the stomach it can be attached to the nose and cheek by means of adhesive tape. Care must be taken in the case of unconscious patients to be sure the tube is not in the larynx. I shall never forget the whistling sound which came from the end of the tube when, as an intern, I once passed a stomach tube into the larynx of a drunken man.

Any liquid food is suitable. Milk should be the chief food, to which may be added eggs, cream and sugar in reasonable quantities. Thin gruels and bouillon may also be used. The food is forced through the tube by means of a syringe (50 cc.) or by gravity from a funnel or a gravity flask. A three-way syringe has been devised for this purpose. If the tube is kept in place, feedings should as a rule be at intervals of from two to four hours, a half pint to a pint to be given each time. After each feeding the tube should be cleansed by the passage of a little water and then air. Recently I nourished a patient with an atypical chronic tetanus very satisfactorily by this means. For several days swallowing was impossible, but we were able via the nasal route to keep the patient well supplied with food and water.

Duodenal Feeding.—This kind of feeding was devised by Einhorn for cases in which it is desirable to rest the stomach. He recommends it particularly for severe gastric or duodenal ulcer, for intense nausea or vomiting and for pronounced gastric atony. The Einhorn or other tube devised for this purpose is passed into the duodenum in the usual manner, and may be permitted to remain in place for a time. The presence of the tube in the duodenum can usually be recognized by the slight tug which is felt when the tube is gently drawn on or by the color and alkaline reaction of the aspirated fluid. The same character of liquid food should be used as that advised above for nasal feeding.

I have not been able to find duodenal feeding the great advantages which have been claimed for it. A patient with peptic ulcer who requires this type of alimentation should have the benefit of operation. The same can be said of gastric atony; for atony or gastrectasia of great degree is usually the result of mechanical obstruction which requires operation for relief. The weight of small amounts of food in the stomach is never a cause of gastric atony, nor will it make this condition worse. Patients with simple gastric atony can be fed much more comfortably in the usual way (see page 525).

The Nutrient Enema.—This furnishes a valuable means of giving both food and water to the patient who for any reason cannot be adequately fed by stomach. There are, however, definite limits both as to the quantity and the kind of food which may be given in this manner; these limits should be clearly recognized by the physician. Instances are recorded in which patients were kept alive for long periods of time by means of nutrient enemas, but it can safely be said that the usefulness of this method of feeding is as a rule limited to a few weeks, say from two to six. Patients nourished solely in this manner get at best only from one-fourth to one third of the nutriment necessary to meet their basal needs. The balance comes from the oxidation of their own tissues. The injected material does not go beyond the ileocecal valve, unless perchance that valve is incompetent, and all absorption therefore as a rule takes place in the colon. Since the large intestine is intended chiefly as a reservoir in which no appreciable digestion takes place and from which only water and salts are normally absorbed, its usefulness as an organ of nutrition is obviously limited.

There is little or no utilization of protein given by rectum. The older formulas for nutrient enemas usually included such protein foods as milk and eggs, but the rationale of this will not stand scrutiny. Boyd[1] reported results which indicated that "Protein food, even when predigested and with salt added, is very poorly absorbed in rectal feeding." Short and Bywater[2] concluded from their studies that practically none of the protein of peptonized milk and eggs prepared in the ordinary manner was utilized. They suggest that if any nitrogen food is absorbed from the large intestine it must be in the form of amino-acids, and that therefore the further the protein cleavage products are split in the process of predigestion the greater the chance of utilization. It would appear that commercially prepared amino-acids—or those of milk which has been peptonized a full twenty-four hours, may possibly be of value for rectal feeding.

The nutritive value of fats given by enema is doubtful. The authors just quoted think they are of little if any value. At any rate, there is no necessity for adding fats to the nutrient enema, since glucose is easily utilized and will accomplish just as much. Alcohol in dilute solution (up to 2 per cent) is readily absorbed and is utilized. It gives nothing, however, which is not supplied equally well by glucose.

Glucose is promptly absorbed from the colon and is readily utilized. It is the one food which is of unquestionable value in the nutrient enema. It should be administered in strengths of from 5 to 10 per cent. Stronger solutions may cause discomfort. It may be given as pure dextrose or as commercial corn syrup.

It is unnecessary to give here the older formulas containing milk and eggs, for such foods when given by rectum are not only of no nutritive value to the patient, but they may also add to his discomfort. Something may be accomplished by the addition to the nutrient enema of commercially prepared amino-acids or skimmed milk which has been peptonized for a full twenty-four hours, but even the value of these is yet to be demonstrated.

The available facts, then, concerning nutrient enemas would indicate that it is seldom if every advisable to include in them anything other than water, glucose and sodium chloride. The most satisfactory form of rectal nourishment is a 5 per cent solution of glucose in tap water. This may be given in daily injections of a pint each or continuously by the Murphy drip. By means of the latter method, as much as 2 quarts of fluid may be given daily under favorable circumstances. This amount will carry comfortably from 100 to 150 Gm. of glucose with a caloric value of from 400 to 600.

For its success this method requires careful technic. The solution should be kept reasonably warm and should be permitted to flow at the rate of from 30 to 40 drops to the minute. Certain additional precautions are advisable for all rectal feeding. The ordinary enema should be given with the patient on his left side or with the foot of the bed elevated; the tube, well lubricated, should be inserted about 5 or 6 inches, and the vessel containing the fluid should be not more than 2 feet above the level of the nozzle. The fluid should be given warm. When abdominal distress is caused or the enema cannot be retained the addition of a little opium, say about 10 drops of laudanum, will often give relief. The rectum must be kept clean, and for this reason a cleansing enema of physiologic salt solution should be given once each day.

Subcutaneous Feeding.—Subcutaneous feeding of carbohydrates and fats holds something of promise, but the amount of food which may be given this way is inconsiderable. At present I cannot regard this method of feeding as of practical value.

Intravenous Feeding.—This is of limited but of definitely practical value. It should not be attempted except when feeding by other routes is not possible. Protein cannot be effectively given in this manner except in the form blood serum; this can be used in emergencies, but, of course, has definite limitations. The danger of anaphylaxis is too great to permit of the continued use of serums from other species. Fat should not be given intravenously because of the danger of embolism. The only foodstuff which can be used for this method of feeding is carbohydrate in the form of dextrose.

Woodyatt, Sansum and Wilder[3] have shown that man can utilize a relatively large amount of glucose if it is given in appropriate amounts and at the proper rate. They gave intravenously solutions of from 10 to 50 per cent strength at a fixed rate so that the patient received not more than 0.85 Gm. of glucose per kilogram of body weight per hour. At this rate all of it was utilized, and it was possible to give an amount of glucose which in caloric value (6,048 calories for a 70 Kg. man) was double the man's basal requirement. If a larger amount per hour per kilogram was given, diuresis was produced and sugar appeared in the urine. A glucose solution of 4.5 per cent is isotonic with the body fluids, but in order to give enough nourishment in this manner stronger solutions should be used. It is best perhaps to give a 10 per cent solution of dextrose in physiologic salt solution. A special pump has been devised by Woodyatt[4] for intravenous injections into experimental animals, by means of which solutions can be delivered at a definitely fixed rate.

In the intravenous administration of glucose solutions certain precautions should be rigidly observed: 1. There should be absolute asepsis. The solution should be prepared on the day used from freshly distilled water and should be thoroughly autoclaved. 2. All tubing and utensils used should be chemically clean as well as aseptic. 3. The injection should be given slowly. For a man of 70 Kg. not more than 60 Gm. of glucose per hour should be given, that is, 600 cc. of a 10 per cent solution.

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COOKING

It is not the province of this book to attempt the teaching of cooking or the preparation of food. Physicians who advise their patients concerning diet, however, are frequently called upon to criticize the preparation of food and to offer suggestions; for not infrequently a patient suffers from nutritional failure because the food at his disposal is poorly prepared, unappetizable and perhaps indigestible. The following brief suggestions are made to the physician who finds it necessary to offer constructive criticism to those who are responsible for the feeding of patients.

Cereals and Gruels.—Cereals are best cooked in a double boiler. They should be cooked over the fire for ten to fifteen minutes and then placed in a double boiler and steamed until thoroughly cooked. Most cereals are cooked too short a time. Oatmeal, for instance, develops a better flavor if cooked for two to three hours or more. Gruels should be thin, not too sweet, nor too highly flavored, and they should be served very hot.

Vegetables.—Vegetables which are properly cooked are not only attractive in appearance and more appetizing, but they are likely to have better food value. The effort, therefore, in cooking vegetables should be to preserve not only their attractiveness and flavor but also their principal nutritive ingredients, sugar, vitamins, and minerals. For the preservation of contained vitamins vegetables should be protected as much as possible from the air during the process of cooking, and the water in which they are boiled should be made moderately acid with vinegar; acidity seems to protect especially Vitamin C. It is advisable too, to boil the water a short time before the vegetables are placed in it in order to remove if possible the contained oxygen.

There are three general methods of cooking vegetables: baking, steaming and boiling. Baking when suitable is the method of choice, since there is no loss of soluble material and no greater destruction of unstable substances than by any other methods. The majority of vegetables, however, must either be steamed or boiled in water. They should not be cooked too long and they should be served as quickly as possible.

The following is the method of choice for the commoner vegetables: (Hygeia). (April, 1924.)

Bake	Steam	Boil (in open kettle)
Irish potatoes	Sweet potatoes	Spinach
Sweet potatoes	Squash	Green peas
Squash	Parsnips	Green beans
	Carrots	Cabbage
	Yellow wax beans	Brussel sprouts
	Beets	Cauliflower
	Spinach	White turnips
	Green peas	Yellow turnips (Rutabagas)
	Green beans	Onions
		Red cabbage.

Meats.—Meats should be roasted, broiled or boiled. Only very tender meats should be roasted or broiled. When prepared in the latter manner, meat should quickly be browned upon both sides on a hot griddle and then broiled in an oven until properly cooked; that is, well-done, medium or rare. In general, the rule should be: rare to medium for beef; well done for lamb, veal and chicken. Tough meats should be placed in boiling water in order to prevent the juices from escaping and then "simmered" until the meat is tender. If the water bubbles it is too hot. The time required for thorough cooking varies with the amount and quality of the meat.

Preparation of Raw Beef.—Scraped beef may be served as a liquid or semi-solid food. A round steak is best utilized for this purpose. The pulp should be obtained by scraping the raw meat with a wide knife; it should then be rolled into thin patties and seared on a hot griddle upon either side and served piping hot.

Soups and Broths.—A meat stock is best prepared by using any suitable meat and boiling it for a long time; the fat is removed by skimming and the meat particles by straining through a wet cloth.

This stock should form the basis of the soups or broth to which there may be added cereal, barley or rice. Well-cooked vegetables cut into small pieces may also be used to thicken the stock.

Eggs.—Eggs play a very important part in any dietary. They should always be fresh, and should be cooked at as low a temperature as possible in order to keep them from becoming tough. For soft boiling, the egg should be placed in boiling water for from three to five minutes; or the vessel containing the boiling water may be immediately removed from the stove and the egg permitted to remain therein ten minutes.

To be hard boiled, the egg should be placed in warm water which is gradually brought to a boil, and then kept at boiling temperature for about ten minutes.

Beverages.—The usual beverages served in the sick-room consist of lemonade, orangeade, grape juice, and gingerale. A combination of flavors gives a more pleasing taste and it is advisable to prepare such a mixture when the aim is to please the palate. For instance, a little lemon juice, pineapple juice or grape juice added to an orangeade improves the flavor.

Milk Drinks.—Drinks that are given for the purpose of materially increasing the caloric intake should consist largely of milk, milk and cream mixtures or milk and egg preparations. Milk shake should be made of rich milk, and either whole egg or egg albumen; it should be flavored with vanilla, cinnamon or any extract of choice and sweetened to taste.

TABLE 1.—*Graded Average Weight in Pounds of Men of Different Statures at Various Ages*
[Copied from Table IV of "Medico-actuarial mortality investigations."]

Age, Years	5 Feet 152 Cm.	5 Feet 1 Inch 155 Cm.	5 Feet 2 Inches 157 Cm.	5 Feet 3 Inches 160 Cm.	5 Feet 4 Inches 163 Cm.	5 Feet 5 Inches 165 Cm.	5 Feet 6 Inches 168 Cm.	5 Feet 7 Inches 170 Cm.	5 Feet 8 Inches 173 Cm.	5 Feet 9 Inches 175 Cm.	5 Feet 10 Inches 177 Cm.	5 Feet 11 Inches 180 Cm.	6 Feet 183 Cm.	6 Feet 1 Inch 185 Cm.	6 Feet 2 Inches 188 Cm.	6 Feet 3 Inches 190 Cm.	6 Feet 4 Inches 192 Cm.	6 Feet 5 Inches 195 Cm.
15	107	109	112	115	118	122	126	130	134	138	142	147	152	157	162	167	172	177
16	109	111	114	117	120	124	128	132	136	140	144	149	154	159	164	169	174	179
17	111	113	116	119	122	126	130	134	138	142	146	151	156	161	166	171	176	181
18	113	115	118	121	124	128	132	136	140	144	148	153	158	163	168	173	178	183
19	115	117	120	123	126	130	134	138	142	146	150	155	160	165	170	175	180	185
20	117	119	122	125	128	132	136	140	144	148	152	156	161	166	171	176	181	186
21	118	120	123	126	130	134	138	141	145	149	153	157	162	167	172	177	182	187
22	119	121	124	127	131	135	139	142	146	150	154	158	163	168	173	178	183	188
23	120	122	125	128	132	136	140	143	147	151	155	159	164	169	175	180	185	190
24	121	123	126	129	133	137	141	144	148	152	156	160	165	171	177	182	187	192
25	122	124	126	129	133	137	141	145	149	153	157	162	167	173	179	184	189	194
26	123	125	127	130	134	138	142	146	150	154	158	163	168	174	180	186	191	196
27	124	126	128	131	134	138	142	146	150	154	158	163	169	175	181	187	192	197
28	125	127	129	132	135	139	143	147	151	155	159	164	170	176	182	188	193	198
29	126	128	130	133	136	140	144	148	152	156	160	165	171	177	183	189	194	199
30	126	128	130	133	136	140	144	148	152	156	161	166	172	178	184	190	196	201
31	127	129	131	134	137	141	145	149	153	157	162	167	173	179	185	191	197	202
32	127	129	131	134	137	141	145	149	154	158	163	168	174	180	186	192	198	203
33	127	129	131	134	137	141	145	149	154	159	164	169	175	181	187	193	199	204
34	128	130	132	135	138	142	146	150	155	160	165	170	176	182	188	194	200	206
35	128	130	132	135	138	142	146	150	155	160	165	170	176	182	189	195	201	207
36	129	131	133	136	139	143	147	151	156	161	166	171	177	183	190	196	202	208
37	129	131	133	136	140	144	148	152	157	162	167	172	178	184	191	197	203	209
38	130	132	134	137	140	144	148	152	157	162	167	173	179	185	192	198	204	210
39	130	132	134	137	140	144	148	152	157	162	167	173	179	185	192	199	205	211
40	131	133	135	138	141	145	149	153	158	163	168	174	180	186	193	200	206	212
41	131	133	135	138	141	145	149	153	158	163	168	174	180	186	193	200	207	213
42	132	134	136	139	142	146	150	154	159	164	169	175	181	187	194	201	208	214
43	132	134	136	139	142	146	150	154	159	164	169	175	181	187	194	201	208	214
44	133	135	137	140	143	147	151	155	160	165	170	176	182	188	195	202	209	215
45	133	135	137	140	143	147	151	155	160	165	170	176	182	188	195	202	209	215
46	134	136	138	141	144	148	152	156	161	166	171	177	183	189	196	203	210	216
47	134	136	138	141	144	148	152	156	161	166	171	177	183	190	197	204	211	217
48	134	136	138	141	144	148	152	156	161	166	171	177	183	190	197	204	211	217
49	134	136	138	141	144	148	152	156	161	166	171	177	183	190	197	204	211	217
50	134	136	138	141	144	148	152	156	161	166	171	177	183	190	197	204	211	217
51	135	137	139	142	145	149	153	157	162	167	172	178	184	191	198	205	212	218
52	135	137	139	142	145	149	153	157	162	167	172	178	184	191	198	205	212	218
53	135	137	139	142	145	149	153	157	162	167	172	178	184	191	198	205	212	218
54	135	137	139	142	145	149	153	158	163	168	173	178	184	191	198	205	212	219
55 and up	135	137	139	142	145	149	153	158	163	168	173	178	184	191	198	205	212	219

* This table is taken from Davenport, C. B.: Body Build and Its Inheritance. **Carnegie Inst. Washington, Publication 329, 1923.**

The Height-Weight-Age Table for boys of school age will be found in the Chapter on the School Child, page 234.

Table 1*a*.—*Graded Average Weight in Pounds of Women of Different Statures at Various Ages**

[Copied from Table IX of "Medico-actuarial mortality investigations."]

Age, Years	4 Feet 8 Inches 142 Cm.	4 Feet 9 Inches 145 Cm.	4 Feet 10 Inches 148 Cm.	4 Feet 11 Inches 150 Cm.	5 Feet 152 Cm.	5 Feet 1 Inch 155 Cm.	5 Feet 2 Inches 157 Cm.	5 Feet 3 Inches 160 Cm.	5 Feet 4 Inches 163 Cm.	5 Feet 5 Inches 165 Cm.	5 Feet 6 Inches 168 Cm.	5 Feet 7 Inches 170 Cm.	5 Feet 8 Inches 173 Cm.	5 Feet 9 Inches 175 Cm.	5 Feet 10 Inches 177 Cm.	5 Feet 11 Inches 180 Cm.	6 Feet 183 Cm.
15	101	103	105	106	107	109	112	115	118	122	126	130	134	138	142	147	152
16	102	104	106	108	109	111	114	117	120	124	128	132	136	139	143	148	153
17	103	105	107	109	111	113	116	119	122	125	129	133	137	140	144	149	154
18	104	106	108	110	112	114	117	120	123	126	130	134	138	141	145	150	155
19	105	107	109	111	113	115	118	121	124	127	131	135	139	142	146	151	155
20	106	108	110	112	114	116	119	122	125	128	132	136	140	143	147	151	156
21	107	109	111	113	115	117	120	123	126	129	133	137	141	144	148	152	156
22	107	109	111	113	115	117	120	123	126	129	133	137	141	145	149	153	157
23	108	110	112	114	116	118	121	124	127	130	134	138	142	146	150	153	157
24	109	111	113	115	117	119	121	124	127	130	134	138	142	146	150	154	158
25	109	111	113	115	117	119	121	124	128	131	135	139	143	147	151	154	158
26	110	112	114	116	118	120	122	125	128	131	135	139	143	147	151	155	159
27	110	112	114	116	118	120	122	125	129	132	136	140	144	148	152	155	159
28	111	113	115	117	119	121	123	126	130	133	137	141	145	149	153	156	160
29	111	113	115	117	119	121	123	126	130	133	137	141	145	149	153	156	160
30	112	114	116	118	120	122	124	127	131	134	138	142	146	150	154	157	161
31	113	115	117	119	121	123	125	128	132	135	139	143	147	151	154	157	161
32	113	115	117	119	121	123	125	128	132	136	140	144	148	152	155	158	162
33	114	116	118	120	122	124	126	129	133	137	141	145	149	153	156	159	162
34	115	117	119	121	123	125	127	130	134	138	142	146	150	154	157	160	163
35	115	117	119	121	123	125	127	130	134	138	142	146	150	154	157	160	163
36	116	118	120	122	124	126	128	131	135	139	143	147	151	155	158	161	164
37	116	118	120	122	124	126	129	132	136	140	144	148	152	156	159	162	165
38	117	119	121	123	125	127	130	133	137	141	145	149	153	157	160	163	166
39	118	120	122	124	126	128	131	134	138	142	146	150	154	158	161	164	167
40	119	121	123	125	127	129	132	135	138	142	146	150	154	158	161	164	167
41	120	122	124	126	128	130	133	136	139	143	147	151	155	159	162	165	168
42	120	122	124	126	128	130	133	136	139	143	147	151	155	159	162	166	169
43	121	123	125	127	129	131	134	137	140	144	148	152	156	160	163	167	170
44	122	124	126	128	130	132	135	138	141	145	149	153	157	161	164	168	171
45	122	124	126	128	130	132	135	138	141	145	149	153	157	161	164	168	171
46	123	125	127	129	131	133	136	139	142	146	150	154	158	162	165	169	172
47	123	125	127	129	131	133	136	139	142	146	151	155	159	163	166	170	173
48	124	126	128	130	132	134	137	140	143	147	152	156	160	164	167	171	174
49	124	126	128	130	132	134	137	140	143	147	152	156	161	165	168	172	175
50	125	127	129	131	133	135	138	141	144	148	152	156	161	165	169	173	176
51	125	127	129	131	133	135	138	141	144	148	152	157	162	166	170	174	177
52	125	127	129	131	133	135	138	141	144	148	152	157	162	166	170	174	177
53	125	127	129	131	133	135	138	141	144	148	152	157	162	166	170	174	177
54	125	127	129	131	133	135	138	141	144	148	153	158	163	167	171	174	177
55	125	127	129	131	133	135	138	141	144	148	153	158	163	167	171	174	177

* This table is taken from Davenport, C. B.: Body Build and its Inheritance, Carnegie Inst. Washington, Publication 329, 1923.

The Height-Weight-Age Table for girls of the school age will be found in the Chapter on the School Child, page 235.

SURFACE AREA

For determining surface area by the DuBois method see Chart on page 60.

PREDICTION FORMULA FOR BASAL METABOLISM

The following tables were prepared by Harris and Benedict* for the convenient prediction of the basal metabolism of men and women when age, height and weight are known. A discussion of the accuracy of these tables together with the formulas on which they are based was given on page 61. The figures in the body of the tables express calories. Table 2 (for men) and Table 4 (for women) concern body weight only; Table 3 (for men) and Table 5 (for women) concern age and height. The figures from two Tables; 2 and 3 for men; and 4 and 5 for women, must be used together. The sum in each instance will give the predicted basal metabolism.

Examples:

Man. 77.2 Kilos 27 Yrs., 172 Cm. Height		Woman. 77.2 Kilos. 22 Yrs., 166 Cm. Height		Woman. 62.3 Kilos. 66 Yrs, 162 Cm. Height.	
From Table 2........	1,128	From Table 4......	1,393	From Table 4.......	1,251
From Table 3........	678	From Table 5.......	204	From Table 5........	−9
Predicted calories....	1,806	Predicted calories..	1,597	Predicted calories...	1,242

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* Harris, J. A., and Benedict, F. G.: Biometric Study of Basal Metabolism in Man, Carnegie Inst. Bull. 279.

TABLE 2.—*Factor for Body-weight in Men*

Kg.	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
25	410	412	413	414	416	417	419	420	421	423
26	424	425	427	428	430	431	432	434	435	436
27	438	439	441	442	443	445	446	447	449	450
28	452	453	454	456	457	458	460	461	463	464
29	465	467	468	469	471	472	474	475	476	478
30	479	480	482	483	485	486	487	489	490	491
31	493	494	496	497	498	500	501	502	504	505
32	507	508	509	511	512	513	515	516	518	519
33	520	522	523	524	526	527	529	530	531	533
34	534	535	537	538	540	541	542	544	545	546
35	548	549	551	552	553	555	556	557	559	560
36	562	563	564	566	567	568	570	571	573	574
37	575	577	578	579	581	582	584	585	586	588
38	589	590	592	593	595	596	597	599	600	601
39	603	604	606	607	608	610	611	612	614	615
40	617	618	619	621	622	623	625	626	628	629
41	630	632	633	634	636	637	639	640	641	643
42	644	645	647	648	650	651	652	654	655	656
43	658	659	661	662	663	665	666	667	669	670
44	672	673	674	676	677	678	680	681	683	684
45	685	687	688	689	691	692	694	695	696	698
46	699	700	702	703	705	706	707	709	710	711
47	713	714	716	717	718	720	721	722	724	725
48	727	728	729	731	732	733	735	736	738	739
49	740	742	743	744	746	747	749	750	751	753
50	754	755	757	758	760	761	762	764	765	766
51	768	769	771	772	773	775	776	777	779	780
52	782	783	784	786	787	788	790	791	793	794
53	795	797	798	799	801	802	804	805	806	808
54	809	810	812	813	815	816	817	819	820	821
55	823	824	826	827	828	830	831	832	834	835
56	837	838	839	841	842	843	845	846	848	849
57	850	852	853	854	856	857	859	860	861	863
58	864	865	867	868	870	871	872	874	875	876
59	878	879	881	882	883	885	886	887	889	890
60	892	893	894	896	897	898	900	901	903	904
61	905	907	908	909	911	912	914	915	916	918
62	919	920	922	923	925	926	927	929	930	931
63	933	934	936	937	938	940	941	942	944	945
64	947	948	949	951	952	953	955	956	958	959
65	960	962	963	964	966	967	969	970	971	973
66	974	975	977	978	980	981	982	984	985	986
67	988	989	991	992	993	995	996	997	999	1000
68	1002	1003	1004	1006	1007	1008	1010	1011	1013	1014
69	1015	1017	1018	1019	1021	1022	1024	1025	1026	1028
70	1029	1030	1032	1033	1035	1036	1037	1039	1040	1041
71	1043	1044	1046	1047	1048	1050	1051	1052	1054	1055
72	1057	1058	1059	1061	1062	1063	1065	1066	1068	1069
73	1070	1072	1073	1074	1076	1077	1079	1080	1081	1083
74	1084	1085	1087	1088	1090	1091	1092	1094	1095	1096

TABLE 2.—*Factor for Body-weight in Men (Continued)*

Kg.	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
75	1098	1099	1101	1102	1103	1105	1106	1107	1109	1110
76	1112	1113	1114	1116	1117	1118	1120	1121	1123	1124
77	1125	1127	1128	1129	1131	1132	1134	1135	1136	1138
78	1139	1140	1142	1143	1145	1146	1147	1149	1150	1151
79	1153	1154	1156	1157	1158	1160	1161	1162	1164	1165
80	1167	1168	1169	1171	1172	1173	1175	1176	1178	1179
81	1180	1182	1183	1184	1186	1187	1189	1190	1191	1193
82	1194	1195	1197	1198	1200	1201	1202	1204	1205	1206
83	1208	1209	1211	1212	1213	1215	1216	1217	1219	1220
84	1222	1223	1224	1226	1227	1228	1230	1231	1233	1234
85	1235	1237	1238	1239	1241	1242	1244	1245	1246	1248
86	1249	1250	1252	1253	1255	1256	1257	1259	1260	1261
87	1263	1264	1266	1267	1268	1270	1271	1272	1274	1275
88	1277	1278	1279	1281	1282	1283	1285	1286	1288	1289
89	1290	1292	1293	1294	1296	1297	1299	1300	1301	1303
90	1304	1305	1307	1308	1310	1311	1312	1314	1315	1316
91	1318	1319	1321	1322	1323	1325	1326	1327	1329	1330
92	1332	1333	1334	1336	1337	1338	1340	1341	1343	1344
93	1345	1347	1348	1349	1351	1352	1354	1355	1356	1358
94	1359	1360	1362	1363	1365	1366	1367	1369	1370	1371
95	1373	1374	1376	1377	1378	1380	1381	1383	1384	1385
96	1387	1388	1389	1391	1392	1394	1395	1396	1398	1399
97	1400	1402	1403	1405	1406	1407	1409	1410	1411	1413
98	1414	1416	1417	1418	1420	1421	1422	1424	1425	1427
99	1428	1429	1431	1432	1433	1435	1436	1438	1439	1440
100	1442	1443	1444	1446	1447	1449	1450	1451	1453	1454
101	1455	1457	1458	1460	1461	1462	1464	1465	1466	1468
102	1469	1471	1472	1473	1475	1476	1477	1479	1480	1482
103	1483	1484	1486	1487	1488	1490	1491	1493	1494	1495
104	1497	1498	1499	1501	1502	1504	1505	1506	1508	1509
105	1510	1512	1513	1515	1516	1517	1519	1520	1521	1523
106	1524	1526	1527	1528	1530	1531	1532	1534	1535	1537
107	1538	1539	1541	1542	1543	1545	1546	1548	1549	1550
108	1552	1553	1554	1556	1557	1559	1560	1561	1563	1564
109	1565	1567	1568	1570	1571	1572	1574	1575	1576	1578
110	1579	1581	1582	1583	1585	1586	1587	1589	1590	1592
111	1593	1594	1596	1597	1598	1600	1601	1603	1604	1605
112	1607	1608	1609	1611	1612	1614	1615	1616	1618	1619
113	1620	1622	1623	1625	1626	1627	1629	1630	1631	1633
114	1634	1636	1637	1638	1640	1641	1642	1644	1645	1647
115	1648	1649	1651	1652	1653	1655	1656	1658	1659	1660
116	1662	1663	1664	1666	1667	1669	1670	1671	1673	1674
117	1675	1677	1678	1680	1681	1682	1684	1685	1686	1688
118	1689	1691	1692	1693	1695	1696	1697	1699	1700	1702
119	1703	1704	1706	1707	1708	1710	1711	1713	1714	1715
120	1717	1718	1719	1721	1722	1724	1725	1726	1728	1729
121	1730	1732	1733	1735	1736	1737	1739	1740	1741	1743
122	1744	1746	1747	1748	1750	1751	1752	1754	1755	1757
123	1758	1759	1761	1762	1763	1765	1766	1768	1769	1770
124	1772	1773	1774	1776	1777	1779	1780	1781	1783	1784

TABLE 3.—*Factor for Stature and Age in Men*

Yrs.	21	22	23	24	25	26	27	28	29	30
Cm.										
151	614	607	600	593	587	580	573	566	560	553
152	619	612	605	598	592	585	578	571	565	558
153	624	617	610	603	597	590	583	576	570	563
154	629	622	615	608	602	595	588	581	575	568
155	634	627	620	613	607	600	593	586	580	573
156	639	632	625	618	612	605	598	591	585	578
157	644	637	630	623	617	610	603	596	590	583
158	649	642	635	628	622	615	608	601	595	588
159	654	647	640	633	627	620	613	606	600	593
160	659	652	645	638	632	625	618	611	605	598
161	664	657	650	643	637	630	623	616	610	603
162	669	662	655	648	642	635	628	621	615	608
163	674	667	660	653	647	640	633	626	620	613
164	679	672	665	658	652	645	638	631	625	618
165	684	677	670	663	657	650	643	636	630	623
166	689	682	675	668	662	655	648	641	635	628
167	694	687	680	673	667	660	653	646	640	633
168	699	692	685	678	672	665	658	651	645	638
169	704	697	690	683	677	670	663	656	650	643
170	709	702	695	688	682	675	668	661	655	648
171	714	707	700	693	687	680	673	666	660	653
172	719	712	705	698	692	685	678	671	665	658
173	724	717	710	703	697	690	683	676	670	663
174	729	722	715	708	702	695	688	681	675	668
175	734	727	720	713	707	700	693	686	680	673
176	739	732	725	718	712	705	698	691	685	678
177	744	737	730	723	717	710	703	696	690	683
178	749	742	735	728	722	715	708	701	695	688
179	754	747	740	733	727	720	713	706	700	693
180	759	752	745	738	732	725	718	711	705	698
181	764	757	750	743	737	730	723	716	710	703
182	769	762	755	748	742	735	728	721	715	708
183	774	767	760	753	747	740	733	726	720	713
184	779	772	765	758	752	745	738	731	725	718
185	784	777	770	763	757	750	743	736	730	723
186	789	782	775	768	762	755	748	741	735	728
187	794	787	780	773	767	760	753	746	740	733
188	799	792	785	779	772	765	758	751	745	738
189	804	797	790	784	777	770	763	756	750	743
190	809	802	795	789	782	775	768	761	755	748
191	814	807	800	794	787	780	773	766	760	753
192	819	812	805	799	792	785	778	771	765	758
193	824	817	810	804	797	790	783	776	770	763
194	829	822	815	809	802	795	788	781	775	768
195	834	827	820	814	807	800	793	787	780	773
196	839	832	825	819	812	805	798	792	785	778
197	844	837	830	824	817	810	803	797	790	783
198	849	842	835	829	822	815	808	802	795	788
199	854	847	840	834	827	820	813	807	800	793
200	859	852	845	839	832	825	818	812	805	798

TABLE 3.—*Factor for Stature and Age in Men* (*Continued*)

Yrs.	31	32	33	34	35	36	37	38	39	40
Cm.										
151	546	539	533	526	519	512	506	499	492	485
152	551	544	538	531	524	517	511	504	497	490
153	556	549	543	536	529	522	516	509	502	495
154	561	554	548	541	534	527	521	514	507	500
155	566	559	553	546	539	532	526	519	512	505
156	571	564	558	551	544	537	531	524	517	510
157	576	569	563	556	549	542	536	529	522	515
158	581	574	568	561	554	547	541	534	527	520
159	586	579	573	566	559	552	546	539	532	525
160	591	584	578	571	564	557	551	544	537	530
161	596	589	583	576	569	562	556	549	542	535
162	601	594	588	581	574	567	561	554	547	540
163	606	599	593	586	579	572	566	559	552	545
164	611	604	598	591	584	577	571	564	557	550
165	616	609	603	596	589	582	576	569	562	555
166	621	614	608	601	594	587	581	574	567	560
167	626	619	613	606	599	592	586	579	572	565
168	631	624	618	611	604	597	591	584	577	570
169	636	629	623	616	609	602	596	589	582	575
170	641	634	628	621	614	607	601	594	587	580
171	646	639	633	626	619	612	606	599	592	585
172	651	644	638	631	624	617	611	604	597	590
173	656	649	643	636	629	622	616	609	602	595
174	661	654	648	641	634	627	621	614	607	600
175	666	659	653	646	639	632	626	619	612	605
176	671	664	658	651	644	637	631	624	617	610
177	676	669	663	656	649	642	636	629	622	615
178	681	674	668	661	654	647	641	634	627	620
179	686	679	673	666	659	652	646	639	632	625
180	691	684	678	671	664	657	651	644	637	630
181	696	689	683	676	669	662	656	649	642	635
182	701	694	688	681	674	667	661	654	647	640
183	706	699	693	686	679	672	666	659	652	645
184	711	704	698	691	684	677	671	664	657	650
185	716	709	703	696	689	682	676	669	662	655
186	721	714	708	701	694	687	681	674	667	660
187	726	719	713	706	699	692	686	679	672	665
188	731	724	718	711	704	697	691	684	677	670
189	736	729	723	716	709	702	696	689	682	675
190	741	734	728	721	714	707	701	694	687	680
191	746	739	733	726	719	712	706	699	692	685
192	751	744	738	731	724	717	711	704	697	690
193	756	749	743	736	729	722	716	709	702	695
194	761	754	748	741	734	727	721	714	707	700
195	766	759	753	746	739	732	726	719	712	705
196	771	764	758	751	744	737	731	724	717	710
197	776	769	763	756	749	742	736	729	722	715
198	781	774	768	761	754	747	741	734	727	720
199	786	779	773	766	759	752	746	739	732	725
200	791	785	778	771	764	757	751	744	737	730

TABLE 3.—*Factor for Stature and Age in Men* (*Continued*)

Yrs.	41	42	43	44	45	46	47	48	49	50
Cm.										
151	479	472	465	458	452	445	438	431	425	418
152	484	477	470	463	457	450	443	436	430	423
153	489	482	475	468	462	455	448	441	435	428
154	494	487	480	473	467	460	453	446	440	433
155	499	492	485	478	472	465	458	451	445	438
156	504	497	490	483	477	470	463	456	450	443
157	509	502	495	488	482	475	468	461	455	448
158	514	507	500	493	487	480	473	466	460	453
159	519	512	505	498	492	485	478	471	465	458
160	524	517	510	503	497	490	483	476	470	463
161	529	522	515	508	502	495	488	481	475	468
162	534	527	520	513	507	500	493	486	480	473
163	539	532	525	518	512	505	498	491	485	478
164	544	537	530	523	517	510	503	496	490	483
165	549	542	535	528	522	515	508	501	495	488
166	554	547	540	533	527	520	513	506	500	493
167	559	552	545	538	532	525	518	511	505	498
168	564	557	550	543	537	530	523	516	510	503
169	569	562	555	548	542	535	528	521	515	508
170	574	567	560	553	547	540	533	526	520	513
171	579	572	565	558	552	545	538	531	525	518
172	584	577	570	563	557	550	543	536	530	523
173	589	582	575	568	562	555	548	541	535	528
174	594	587	580	573	567	560	553	546	540	533
175	599	592	585	578	572	565	558	551	545	538
176	604	597	590	583	577	570	563	556	550	543
177	609	602	595	588	582	575	568	561	555	548
178	614	607	600	593	587	580	573	566	560	553
179	619	612	605	598	592	585	578	571	565	558
180	624	617	610	603	597	590	583	576	570	563
181	629	622	615	608	602	595	588	581	575	568
182	634	627	620	613	607	600	593	586	580	573
183	639	632	625	618	612	605	598	591	585	578
184	644	637	630	623	617	610	603	596	590	583
185	649	642	635	628	622	615	608	601	595	588
186	654	647	640	633	627	620	613	606	600	593
187	659	652	645	638	632	625	618	611	605	598
188	664	657	650	643	637	630	623	616	610	603
189	669	662	655	648	642	635	628	621	615	608
190	674	667	660	653	647	640	633	626	620	613
191	679	672	665	658	652	645	638	631	625	618
192	684	677	670	663	657	650	643	636	630	623
193	689	682	675	668	662	655	648	641	635	628
194	694	687	680	673	667	660	653	646	640	633
195	699	692	685	678	672	665	658	651	645	638
196	704	697	690	683	677	670	663	656	650	643
197	709	702	695	688	682	675	668	661	655	648
198	714	707	700	693	687	680	673	666	660	653
199	719	712	705	698	692	685	678	671	665	658
200	724	717	710	703	697	690	683	676	670	663

TABLE 3.—*Factor for Stature and Age in Men* (*Continued*)

Yrs.	51	52	53	54	55	56	57	58	59	60
Cm.										
151	411	404	397	391	384	377	370	364	357	350
152	416	409	402	396	389	382	375	369	362	355
153	421	414	407	401	394	387	380	374	367	360
154	426	419	412	406	399	392	385	379	372	365
155	431	424	417	411	404	397	390	384	377	370
156	436	429	422	416	409	402	395	389	382	375
157	441	434	428	421	414	407	400	394	387	380
158	446	439	433	426	419	412	405	399	392	385
159	451	444	438	431	424	417	410	404	397	390
160	456	449	443	436	429	422	415	409	402	395
161	461	454	448	441	434	427	420	414	407	400
162	466	459	453	446	439	432	425	419	412	405
163	471	464	458	451	444	437	431	424	417	410
164	476	469	463	456	449	442	436	429	422	415
165	481	474	468	461	454	447	441	434	427	420
166	486	479	473	466	459	452	446	439	432	425
167	491	484	478	471	464	457	451	444	437	430
168	496	489	483	476	469	462	456	449	442	435
169	501	494	488	481	474	467	461	454	447	440
170	506	499	493	486	479	472	466	459	452	445
171	511	504	498	491	484	477	471	464	457	450
172	516	509	503	496	489	482	476	469	462	455
173	521	514	508	501	494	487	481	474	467	460
174	526	519	513	506	499	492	486	479	472	465
175	531	524	518	511	504	497	491	484	477	470
176	536	529	523	516	509	502	496	489	482	475
177	541	534	528	521	514	507	501	494	487	480
178	546	539	533	526	519	512	506	499	492	485
179	551	544	538	531	524	517	511	504	497	490
180	556	549	543	536	529	522	516	509	502	495
181	561	554	548	541	534	527	521	514	507	500
182	566	559	553	546	539	532	526	519	512	505
183	571	564	558	551	544	537	531	524	517	510
184	576	569	563	556	549	542	536	529	522	515
185	581	574	568	561	554	547	541	534	527	520
186	586	579	573	566	559	552	546	539	532	525
187	591	584	578	571	564	557	551	544	537	530
188	596	589	583	576	569	562	556	549	542	535
189	601	594	588	581	574	567	561	554	547	540
190	606	599	593	586	579	572	566	559	552	545
191	611	604	598	591	584	577	571	564	557	550
192	616	609	603	596	589	582	576	569	562	555
193	621	614	608	601	594	587	581	574	567	560
194	626	619	613	606	599	592	586	579	572	565
195	631	624	618	611	604	597	591	584	577	570
196	636	629	623	616	609	602	596	589	582	575
197	641	634	628	621	614	607	601	594	587	580
198	646	639	633	626	619	612	606	599	592	585
199	651	644	638	631	624	617	611	604	597	590
200	656	649	643	636	629	622	616	609	602	595

TABLE 3.—*Factor for Stature and Age in Men (Continued)*

Yrs.	61	62	63	64	65	66	67	68	69	70
Cm.										
151	343	337	330	323	316	310	303	296	289	283
152	348	342	335	328	321	315	308	301	294	288
153	353	347	340	333	326	320	313	306	299	293
154	358	352	345	338	331	325	318	311	304	298
155	363	357	350	343	336	330	323	316	309	303
156	368	362	355	348	341	335	328	321	314	308
157	373	367	360	353	346	340	333	326	319	313
158	378	372	365	358	351	345	338	331	324	318
159	383	377	370	363	356	350	343	336	329	323
160	388	382	375	368	361	355	348	341	334	328
161	393	387	380	373	366	360	353	346	339	333
162	398	392	385	378	371	365	358	351	344	338
163	403	397	390	383	376	370	363	356	349	343
164	408	402	395	388	381	375	368	361	354	348
165	413	407	400	393	386	380	373	366	359	353
166	418	412	405	398	391	385	378	371	364	358
167	423	417	410	403	396	390	383	376	369	363
168	428	422	415	408	401	395	388	381	374	368
169	434	427	420	413	406	400	393	386	379	373
170	439	432	425	418	411	405	398	391	384	378
171	444	437	430	423	416	410	403	396	389	383
172	449	442	435	428	421	415	408	401	394	388
173	454	447	440	433	426	420	413	406	399	393
174	459	452	445	438	431	425	418	411	404	398
175	464	457	450	443	437	430	423	416	409	403
176	469	462	455	448	442	435	428	421	414	408
177	474	467	460	453	447	440	433	426	419	413
178	479	472	465	458	452	445	438	431	424	418
179	484	477	470	463	457	450	443	436	429	423
180	489	482	475	468	462	455	448	441	434	428
181	494	487	480	473	467	460	453	446	440	433
182	499	492	485	478	472	465	458	451	445	438
183	504	497	490	483	477	470	463	456	450	443
184	509	502	495	488	482	475	468	461	455	448
185	514	507	500	493	487	480	473	466	460	453
186	519	512	505	498	492	485	478	471	465	458
187	524	517	510	503	497	490	483	476	470	463
188	529	522	515	508	502	495	488	481	475	468
189	534	527	520	513	507	500	493	486	480	473
190	539	532	525	518	512	505	498	491	485	478
191	544	537	530	523	517	510	503	496	490	483
192	549	542	535	528	522	515	508	501	495	488
193	554	547	540	533	527	520	513	506	500	493
194	559	552	545	538	532	525	518	511	505	498
195	564	557	550	543	537	530	523	516	510	503
196	569	562	555	548	542	535	528	521	515	508
197	574	567	560	553	547	540	533	526	520	513
198	579	572	565	558	552	545	538	531	525	518
199	584	577	570	563	557	550	543	536	530	523
200	589	582	575	568	562	555	548	541	535	528

TABLE 4.—*Factor for Body-weight in Women*

Kg.	.0	.1	.2	.3	4	.5	.6	.7	.8	.9
25	894	895	896	897	898	899	900	901	902	903
26	904	905	906	907	908	909	909	910	911	912
27	913	914	915	916	917	918	919	920	921	922
28	923	924	925	926	927	928	929	930	931	931
29	932	933	934	935	936	937	938	939	940	941
30	942	943	944	945	946	947	948	949	950	951
31	952	953	953	954	955	956	957	958	959	960
32	961	962	963	964	965	966	967	968	969	970
33	971	972	973	974	975	975	976	977	978	979
34	980	981	982	983	984	985	986	987	988	989
35	990	991	992	993	994	995	996	997	997	998
36	999	1000	1001	1002	1003	1004	1005	1006	1007	1008
37	1009	1010	1011	1012	1013	1014	1015	1016	1017	1018
38	1019	1019	1020	1021	1022	1023	1024	1025	1026	1027
39	1028	1029	1030	1031	1032	1033	1034	1035	1036	1037
40	1038	1039	1040	1041	1041	1042	1043	1044	1045	1046
41	1047	1048	1049	1050	1051	1052	1053	1054	1055	1056
42	1057	1058	1059	1060	1061	1062	1062	1063	1064	1065
43	1066	1067	1068	1069	1070	1071	1072	1073	1074	1075
44	1076	1077	1078	1079	1080	1081	1082	1083	1084	1084
45	1085	1086	1087	1088	1089	1090	1091	1092	1093	1094
46	1095	1096	1097	1098	1099	1100	1101	1102	1103	1104
47	1105	1106	1106	1107	1108	1109	1110	1111	1112	1113
48	1114	1115	1116	1117	1118	1119	1120	1121	1122	1123
49	1124	1125	1126	1127	1128	1128	1129	1130	1131	1132
50	1133	1134	1135	1136	1137	1138	1139	1140	1141	1142
51	1143	1144	1145	1146	1147	1148	1149	1150	1150	1151
52	1152	1153	1154	1155	1156	1157	1158	1159	1160	1161
53	1162	1163	1164	1165	1166	1167	1168	1169	1170	1171
54	1172	1172	1173	1174	1175	1176	1177	1178	1179	1180
55	1181	1182	1183	1184	1185	1186	1187	1188	1189	1190
56	1191	1192	1193	1194	1194	1195	1196	1197	1198	1199
57	1200	1201	1202	1203	1204	1205	1206	1207	1208	1209
58	1210	1211	1212	1213	1214	1215	1216	1216	1217	1218
59	1219	1220	1221	1222	1223	1224	1225	1226	1227	1228
60	1229	1230	1231	1232	1233	1234	1235	1236	1237	1238
61	1238	1239	1240	1241	1242	1243	1244	1245	1246	1247
62	1248	1249	1250	1251	1252	1253	1254	1255	1256	1257
63	1258	1259	1260	1260	1261	1262	1263	1264	1265	1266
64	1267	1268	1269	1270	1271	1272	1273	1274	1275	1276
65	1277	1278	1279	1280	1281	1281	1282	1283	1284	1285
66	1286	1287	1288	1289	1290	1291	1292	1293	1294	1295
67	1296	1297	1298	1299	1300	1301	1302	1303	1303	1304
68	1305	1306	1307	1308	1309	1310	1311	1312	1313	1314
69	1315	1316	1317	1318	1319	1320	1321	1322	1323	1324
70	1325	1325	1326	1327	1328	1329	1330	1331	1332	1333
71	1334	1335	1336	1337	1338	1339	1340	1341	1342	1343
72	1344	1345	1346	1347	1347	1348	1349	1350	1351	1352
73	1353	1354	1355	1356	1357	1358	1359	1360	1361	1362
74	1363	1364	1365	1366	1367	1368	1369	1369	1370	1371

TABLE 4.—*Factor for Body-weight in Women (Continued)*

Kg.	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
75	1372	1373	1374	1375	1376	1377	1378	1379	1380	1381
76	1382	1383	1384	1385	1386	1387	1388	1389	1390	1391
77	1391	1392	1393	1394	1395	1396	1397	1398	1399	1400
78	1401	1402	1403	1404	1405	1406	1407	1408	1409	1410
79	1411	1412	1413	1413	1414	1415	1416	1417	1418	1419
80	1420	1421	1422	1423	1424	1425	1426	1427	1428	1429
81	1430	1431	1432	1433	1434	1435	1435	1436	1437	1438
82	1439	1440	1441	1442	1443	1444	1445	1446	1447	1448
83	1449	1450	1451	1452	1453	1454	1455	1456	1457	1457
84	1458	1459	1460	1461	1462	1463	1464	1465	1466	1467
85	1468	1469	1470	1471	1472	1473	1474	1475	1476	1477
86	1478	1479	1479	1480	1481	1482	1483	1484	1485	1486
87	1487	1488	1489	1490	1491	1492	1493	1494	1495	1496
88	1497	1498	1499	1500	1501	1501	1502	1503	1504	1505
89	1506	1507	1508	1509	1510	1511	1512	1513	1514	1515
90	1516	1517	1518	1519	1520	1521	1522	1522	1523	1524
91	1525	1526	1527	1528	1529	1530	1531	1532	1533	1534
92	1535	1536	1537	1538	1539	1540	1541	1542	1543	1544
93	1544	1545	1546	1547	1548	1549	1550	1551	1552	1553
94	1554	1555	1556	1557	1558	1559	1560	1561	1562	1563
95	1564	1565	1566	1566	1567	1568	1569	1570	1571	1572
96	1573	1574	1575	1576	1577	1578	1579	1580	1581	1582
97	1583	1584	1585	1586	1587	1588	1588	1589	1590	1591
98	1592	1593	1594	1595	1596	1597	1598	1599	1600	1601
99	1602	1603	1604	1605	1606	1607	1608	1609	1610	1610
100	1611	1612	1613	1614	1615	1616	1617	1618	1619	1620
101	1621	1622	1623	1624	1625	1626	1627	1628	1629	1630
102	1631	1632	1632	1633	1634	1635	1636	1637	1638	1639
103	1640	1641	1642	1643	1644	1645	1646	1647	1648	1649
104	1650	1651	1652	1653	1654	1654	1655	1656	1657	1658
105	1659	1660	1661	1662	1663	1664	1665	1666	1667	1668
106	1669	1670	1671	1672	1673	1674	1675	1676	1676	1677
107	1678	1679	1680	1681	1682	1683	1684	1685	1686	1687
108	1688	1689	1690	1691	1692	1693	1694	1695	1696	1697
109	1698	1698	1699	1700	1701	1702	1703	1704	1705	1706
110	1707	1708	1709	1710	1711	1712	1713	1714	1715	1716
111	1717	1718	1719	1720	1720	1721	1722	1723	1724	1725
112	1726	1727	1728	1729	1730	1731	1732	1733	1734	1735
113	1736	1737	1738	1739	1740	1741	1741	1742	1743	1744
114	1745	1746	1747	1748	1749	1750	1751	1752	1753	1754
115	1755	1756	1757	1758	1759	1760	1761	1762	1763	1763
116	1764	1765	1766	1767	1768	1769	1770	1771	1772	1773
117	1774	1775	1776	1777	1778	1779	1780	1781	1782	1783
118	1784	1785	1785	1786	1787	1788	1789	1790	1791	1792
119	1793	1794	1795	1796	1797	1798	1799	1800	1801	1802
120	1803	1804	1805	1806	1807	1807	1808	1809	1810	1811
121	1812	1813	1814	1815	1816	1817	1818	1819	1820	1821
122	1822	1823	1824	1825	1826	1827	1828	1829	1829	1830
123	1831	1832	1833	1834	1835	1836	1837	1838	1839	1840
124	1841	1842	1843	1844	1845	1846	1847	1848	1849	1850

TABLE 5.—*Factor for Stature and Age in Women*

Yrs.	21	22	23	24	25	26	27	28	29	30
Cm.										
151	181	176	172	167	162	158	153	148	144	139
152	183	178	174	169	164	160	155	150	146	141
153	185	180	175	171	166	161	157	152	147	143
154	187	182	177	173	168	163	159	154	149	145
155	189	184	179	174	170	165	160	156	151	146
156	190	186	181	176	172	167	162	158	153	148
157	192	188	183	178	173	169	164	159	155	150
158	194	189	185	180	175	171	166	161	157	152
159	196	191	187	182	177	173	168	163	158	154
160	198	193	188	184	179	174	170	165	160	156
161	199	195	190	186	181	176	172	167	162	158
162	201	197	192	187	183	178	173	169	164	159
163	203	199	194	189	185	180	175	171	166	161
164	205	200	196	191	186	182	177	172	168	163
165	207	202	198	193	188	184	179	174	170	165
166	209	204	199	194	190	185	181	176	171	167
167	211	206	201	197	192	187	183	178	173	169
168	213	208	203	199	194	189	184	180	175	170
169	214	210	205	200	196	191	186	182	177	172
170	216	212	207	202	198	193	188	184	179	174
171	218	213	209	204	199	195	190	185	181	176
172	220	215	211	206	201	197	192	187	183	178
173	222	217	212	208	203	198	194	189	184	180
174	224	219	214	210	205	200	196	191	186	182
175	225	221	216	211	207	202	197	193	188	183
176	227	223	218	213	209	204	199	195	190	185
177	229	225	220	215	210	206	201	196	192	187
178	231	226	222	217	212	208	203	198	194	189
179	233	228	224	219	214	210	205	200	195	191
180	235	230	225	221	216	211	207	202	197	193
181	237	232	227	223	218	213	209	204	199	195
182	238	234	229	224	220	215	210	206	201	196
183	240	236	231	226	222	217	212	208	203	198
184	242	237	233	228	223	219	214	209	205	200
185	244	239	235	230	225	221	216	211	207	202
186	246	241	236	232	227	222	218	213	208	204
187	248	243	238	234	229	224	220	215	210	206
188	250	245	240	236	231	226	221	217	212	207
189	251	247	242	237	233	228	223	219	214	209
190	253	249	244	239	235	230	225	221	216	211
191	255	250	246	241	236	232	227	222	218	213
192	257	252	248	243	238	234	229	224	220	215
193	259	254	249	245	240	235	231	226	221	217
194	261	256	251	247	242	237	233	228	223	219
195	262	258	253	248	244	239	234	230	225	220
196	264	260	255	250	246	241	236	232	227	222
197	266	262	257	252	247	243	238	233	229	224
198	268	263	259	254	249	245	240	235	231	226
199	270	265	261	256	251	247	242	237	232	228
200	272	267	262	258	253	248	244	239	234	230

TABLE 5.—*Factor for Stature and Age in Women* (*Continued*)

Yrs.	31	32	33	34	35	36	37	38	39	40
Cm.										
151	134	130	125	120	116	111	106	102	97	92
152	136	132	127	122	117	113	108	103	99	94
153	138	133	129	124	119	115	110	105	101	96
154	140	135	131	126	121	117	112	107	102	98
155	142	137	132	128	123	118	114	109	104	100
156	144	139	134	130	125	120	116	111	106	102
157	145	141	136	131	127	122	117	113	108	103
158	147	143	138	133	129	124	119	115	110	105
159	149	144	140	135	130	126	121	116	112	107
160	151	146	142	137	132	128	123	118	114	109
161	153	148	143	139	134	129	125	120	115	111
162	155	150	145	141	136	131	127	122	117	113
163	157	152	147	143	138	133	128	124	119	114
164	158	154	149	144	140	135	130	126	121	116
165	160	156	151	146	142	137	132	128	123	118
166	162	157	153	148	143	139	134	129	125	120
167	164	159	155	150	145	141	136	131	127	122
168	166	161	156	152	147	142	138	133	128	124
169	168	163	158	154	149	144	140	135	130	126
170	169	165	160	155	151	146	141	137	132	127
171	171	167	162	157	153	148	143	139	134	129
172	173	169	164	159	154	150	145	140	136	131
173	175	170	166	161	156	152	147	142	138	133
174	177	172	168	163	158	154	149	144	139	135
175	179	174	169	165	160	155	151	146	141	137
176	181	176	171	167	162	157	153	148	143	139
177	182	178	173	168	164	159	154	150	145	140
178	184	180	175	170	166	161	156	152	147	142
179	186	181	177	172	167	163	158	153	149	144
180	188	183	179	174	169	165	160	155	151	146
181	190	185	180	176	171	166	162	157	152	148
182	192	187	182	178	173	168	164	159	154	150
183	194	189	184	180	175	170	165	161	156	151
184	195	191	186	181	177	172	167	163	158	153
185	197	193	188	183	179	174	169	165	160	155
186	199	194	190	185	180	176	171	166	162	157
187	201	196	192	187	182	178	173	168	164	159
188	203	198	193	189	184	179	175	170	165	161
189	205	200	195	191	186	181	177	172	167	163
190	206	202	197	192	188	183	178	174	169	164
191	208	204	199	194	190	185	180	176	171	166
192	210	206	201	196	191	187	182	177	173	168
193	212	207	203	198	193	189	184	179	175	170
194	214	209	205	200	195	191	186	181	176	172
195	216	211	206	202	197	192	188	183	178	174
196	218	213	208	204	199	194	190	185	180	175
197	219	215	210	205	201	196	191	187	182	177
198	221	217	212	207	203	198	193	189	184	179
199	223	218	214	209	204	200	195	190	186	181
200	225	220	216	211	206	202	197	192	188	183

TABLE 5.—*Factor for Stature and Age in Women* (*Continued*)

Yrs.	41	42	43	44	45	46	47	48	49	50
Cm.										
151	88	83	78	74	69	64	60	55	50	46
152	89	85	80	75	71	66	61	57	52	47
153	91	87	82	77	73	68	63	59	54	49
154	93	88	84	79	74	70	65	60	56	51
155	95	90	86	81	76	72	67	62	58	53
156	97	92	87	83	78	73	69	64	59	55
157	99	94	89	85	80	75	71	66	61	57
158	101	96	91	87	82	77	72	68	63	58
159	102	98	93	88	84	79	74	70	65	60
160	104	100	95	90	86	81	76	72	67	62
161	106	101	97	92	87	83	78	73	69	64
162	108	103	99	94	89	85	80	75	71	66
163	110	105	100	96	91	86	82	77	72	68
164	112	107	102	98	93	88	84	79	74	70
165	113	109	104	99	95	90	85	81	76	71
166	115	111	106	101	97	92	87	83	78	73
167	117	113	108	103	98	94	89	84	80	75
168	119	114	110	105	100	96	91	86	82	77
169	121	116	112	107	102	98	93	88	83	79
170	123	118	113	109	104	99	95	90	85	81
171	125	120	115	111	106	101	97	92	87	83
172	126	122	117	112	108	103	98	94	89	84
173	128	124	119	114	110	105	100	96	91	86
174	130	125	121	116	111	107	102	97	93	88
175	132	127	123	118	113	109	104	99	95	90
176	134	129	124	120	115	110	106	101	96	92
177	136	131	126	122	117	112	108	103	98	94
178	138	133	128	124	119	114	109	105	100	95
179	139	135	130	125	121	116	111	107	102	97
180	141	137	132	127	123	118	113	108	104	99
181	143	138	134	129	124	120	115	110	106	101
182	145	140	136	131	126	122	117	112	108	103
183	147	142	137	133	128	123	119	114	109	105
184	149	144	139	135	130	125	121	116	111	107
185	150	146	141	136	132	127	122	118	113	108
186	152	148	143	138	134	129	124	120	115	110
187	154	150	145	140	135	131	126	121	117	112
188	156	151	147	142	137	133	128	123	119	114
189	158	153	149	144	139	134	130	125	120	116
190	160	155	150	146	141	136	132	127	122	118
191	162	157	152	148	143	138	134	129	124	119
192	163	159	154	149	145	140	135	131	126	121
193	165	161	156	151	147	142	137	133	128	123
194	167	162	158	153	148	144	139	134	130	125
195	169	164	160	155	150	146	141	136	132	127
196	171	166	161	157	152	147	143	138	133	129
197	173	168	163	159	154	149	145	140	135	131
198	175	170	165	160	156	151	146	142	137	132
199	176	172	167	162	158	153	148	144	139	134
200	178	174	169	164	160	155	150	145	141	136

TABLE 5.—*Factor for Stature and Age in Women (Continued)*

Yrs.	51	52	53	54	55	56	57	58	59	60
Cm.										
151	41	36	31	27	22	17	13	8	3	−1.2
152	43	38	33	29	24	19	15	10	5	0.6
153	45	40	35	31	26	21	16	12	7	2
154	46	42	37	32	28	23	18	14	9	4
155	48	44	39	34	30	25	20	16	11	6
156	50	45	41	36	31	27	22	17	13	8
157	52	47	43	38	33	29	24	19	15	10
158	54	49	44	40	35	30	26	21	16	12
159	56	51	46	42	37	32	28	23	18	14
160	57	53	48	43	39	34	29	25	20	15
161	59	55	50	45	41	36	31	27	22	17
162	61	57	52	47	42	38	33	28	24	19
163	63	58	54	49	44	40	35	30	26	21
164	65	60	56	51	46	42	37	32	27	23
165	67	62	57	53	48	43	39	34	29	25
166	69	64	59	55	50	45	41	36	31	26
167	70	66	61	56	52	47	42	38	33	28
168	72	68	63	58	54	49	44	40	35	30
169	74	69	65	60	55	51	46	41	37	32
170	76	71	67	62	57	53	48	43	39	34
171	78	73	68	64	59	54	50	45	40	36
172	80	75	70	66	61	56	52	47	42	38
173	82	77	72	67	63	58	53	49	44	39
174	83	79	74	69	65	60	55	51	46	41
175	85	81	76	71	67	62	57	52	48	43
176	87	82	78	73	68	64	59	54	50	45
177	89	84	80	75	70	66	61	56	52	47
178	91	86	81	77	72	67	63	58	53	49
179	93	88	83	79	74	69	65	60	55	51
180	94	90	85	80	76	71	66	62	57	52
181	96	92	87	82	78	73	68	64	59	54
182	98	93	89	84	79	75	70	65	61	56
183	100	95	91	86	81	77	72	67	63	58
184	102	97	93	88	83	78	74	69	64	60
185	104	99	94	90	85	80	76	71	66	62
186	106	101	96	92	87	82	78	73	68	63
187	107	103	98	93	89	84	79	75	70	65
188	109	105	100	95	91	86	81	77	72	67
189	111	106	102	97	92	88	83	78	74	69
190	113	108	104	99	94	90	85	80	76	71
191	115	110	105	101	96	91	87	82	77	73
192	117	112	107	103	98	93	89	84	79	75
193	119	114	109	104	100	95	90	86	81	76
194	120	116	111	106	102	97	92	88	83	78
195	122	118	113	108	104	99	94	89	85	80
196	124	119	115	110	105	101	96	91	87	82
197	126	121	117	112	107	103	98	93	89	84
198	128	123	118	114	109	104	100	95	90	86
199	130	125	120	116	111	106	102	97	92	88
200	131	127	122	117	113	108	103	99	94	89

TABLE 5.—*Factor for Stature and Age in Women (Continued)*

Yrs.	61	62	63	64	65	66	67	68	69	70
Cm.										
151	−6	−11	−15	−20	−25	−29	−34	−39	−43	−48
152	−4	− 9	−13	−18	−23	−27	−32	−37	−41	−46
153	−2	− 7	−12	−16	−21	−26	−30	−35	−40	−44
154	−0	− 5	−10	−14	−19	−24	−28	−33	−38	−42
155	1	− 3	− 8	−13	−17	−22	−27	−31	−36	−41
156	3	− 1	− 6	−11	−15	−20	−25	−29	−34	−39
157	5	1	− 4	− 9	−14	−18	−23	−28	−32	−37
158	7	2	− 2	− 7	−12	−16	−21	−26	−30	−35
159	9	4	− 0	− 5	−10	−15	−19	−24	−29	−33
160	11	6	1	− 3	− 8	−13	−17	−22	−27	−31
161	13	8	3	− 1	− 6	−11	−15	−20	−25	−30
162	14	10	5	0	− 4	− 9	−14	−18	−23	−28
163	16	12	7	2	− 2	− 7	−12	−16	−21	−26
164	18	13	9	4	− 1	− 5	−10	−15	−19	−24
165	20	15	11	6	1	− 3	− 8	−13	−17	−22
166	22	17	12	8	3	− 2	− 6	−11	−16	−20
167	24	19	14	10	5	0	− 4	− 9	−14	−18
168	26	21	16	11	7	2	− 3	− 7	−12	−17
169	27	23	18	13	9	4	− 1	− 5	−10	−15
170	29	25	20	15	11	6	1	− 4	− 8	−13
171	31	26	22	17	12	8	3	− 2	− 6	−11
172	33	28	24	19	14	10	5	0	− 4	− 9
173	35	30	25	21	16	11	7	2	− 3	− 7
174	37	32	27	23	18	13	9	4	− 1	− 5
175	38	34	29	24	20	15	10	6	1	− 4
176	40	36	31	26	22	17	12	8	3	− 2
177	42	37	33	28	23	19	14	9	5	0
178	44	39	35	30	25	21	16	11	7	2
179	46	41	37	32	27	22	18	13	8	4
180	48	43	38	34	29	24	20	15	10	6
181	50	45	40	36	31	26	22	17	12	8
182	51	47	42	37	33	28	23	19	14	9
183	53	49	44	39	35	30	25	21	16	11
184	55	50	46	41	36	32	27	22	18	13
185	57	52	48	43	38	34	29	24	20	15
186	59	54	49	45	40	35	31	26	21	17
187	61	56	51	47	42	37	33	28	23	19
188	63	58	53	48	44	39	34	30	25	20
189	64	60	55	50	46	41	36	32	27	22
190	66	62	57	52	48	43	38	33	29	24
191	68	63	59	54	49	45	40	35	31	26
192	70	65	61	56	51	47	42	37	33	28
193	72	67	62	58	53	48	44	39	34	30
194	74	69	64	60	55	50	46	41	36	32
195	75	71	66	61	57	52	47	43	38	33
196	77	73	68	63	59	54	49	45	40	35
197	79	74	70	65	60	56	51	46	42	37
198	81	76	72	67	62	58	53	48	44	39
199	83	78	74	69	64	59	55	50	45	41
200	85	80	75	71	66	61	57	52	47	43

Table 6.—*Table of Equivalents*

1 kilogram = 2.2046 pounds
1 pound = 453.6 grams
1 ounce = 28.3 grams
1 liter = 61.027 cubic inches 1.7068 pints
1 gram-calorie = 0.425 kilogram-meters of mechanical energy
1 meter = 3.2809 feet
1 kilometer = 0.6214 miles

1 teaspoon Fluid = 5 c.c. or ⅙ fluid ounce
1 dessertspoon Fluid = 10 c.c. or ⅓ fluid ounce
1 tablespoon Fluid = 15 c.c. or ½ fluid ounce
1 ordinary cup Fluid = 250 c.c. or 8 fluid ounce
1 tumbler or glass Fluid = 250 c.c. or 8 fluid ounce
1 cordial glass Fluid = 20 c.c. or ⅔ fluid ounce
1 sherry glass Fluid = 30 c.c. or 1 fluid ounce
1 cocktail glass Fluid 75 c.c. or 2½ fluid ounce
1 claret glass Fluid = 120 c.c. or 4 fluid ounce
1 champagne glass Fluid = 135 c.c. or 4½ fluid ounce

ABBREVIATIONS

a. = average.
a. h. = average helping.
c. = cup.
d. = diameter.
dsp. = dessertspoon.
h. = heaping.
m. = medium.
sq. = square.
tbsp. = tablespoon.
tsp. = teaspoon.

FOOD VALUES

The following tables of food values are taken from Locke, Edwin A. "Food Values," Appleton & Co., N. Y., and are published here through the courtesy of the author.

TABLE 7.—*Prepared Foods—Edible Portion**

(The small numerals in the first column refer to the list of references on page 731.)

FOOD STUFFS.	Portion.	Quantity.	Weight.	Water.	Protein.		Fats.		Carbohydrates.		Total Calories.	Calories per 100 Grams.
			Grams.	Grams.	Grams.	Calories.	Grams.	Calories.	Grams.	Calories.		
1. MEATS.												
Beef:												
Beef juice	a. h.	4 oz.	120	111.60	5.88	24.1	0.72	6.7	......	.....	31	25
Corned beef, canned	a. h.	1 slice.	50	25.90	13.15	53.9	9.35	87.0	......	.....	141	282
Corned beef hash	a. h.	2 h. tbsp.	100	80.30	6.00	24.6	1.90	17.7	9.40	38.5	81	81
Roast	a. h.	1 slice.	100	48.20	22.30	91.4	28.60	266.0	......	.....	357	357
Roast, very lean[2]	a. h.	1 "	100	73.71	23.33	95.7	1.66	15.4	......	.....	111	111
Scraped (round), approximate	a. h.	4-in. pat.	100	67.80	20.90	85.7	10.60	98.6	......	.....	184	184

* In this table the figures given are for the edible portion in every case unless otherwise specified.

So far as possible the values of the various prepared dishes have been computed from Atwater's chemical analyses in order that the table may be as uniform as possible. When the authority is not indicated, therefore, it is understood that the figures were taken from this source. The recipes in the case of made dishes, like puddings, sauces, etc., have been taken from many sources, but chiefly from Sachse: "How to Cook for the Sick and Convalescent."

In a given group of foods as roast meats and soups, the quantity served has been somewhat arbitrarily made the same, as in this way the relative values are best indicated. The fractions in the weights of the average serving have uniformly been disregarded, as also in the case of the total calories. When the ingredients are stated, as in

TABLE 7.—*Prepared Foods—Edible Portion* (*Continued*)

FOOD STUFFS.	Portion.	Quantity.	Weight.	Water.	Protein.		Fats.		Carbohydrates.		Total Calories.	Calories per 100 Grams.
			Grams.	Grams.	Grams.	Calories.	Grams.	Calories.	Grams.	Calories.		
Beef—Continued.												
Steak, round, fat removed	a. h.	1 slice.	100	63.00	27.60	113.2	7.70	71.6	......	.....	185	185
Steak, tenderloin	a. h.	1 “	100	54.80	23.50	96.4	20.40	189.7	......	.....	286	286
Sweetbread²	a. h.	1 “	80	45.95	32.00	131.2	0.45	4.2	......	.....	135	169
Tongue, canned	a. h.	1 “	25	12.83	4.88	20.0	5.80	53.9	......	.....	74	295
Chicken:												
Capon	a. h.	1 slice.	100	59.90	27.00	110.7	11.50	107.0	......	.....	218	218
Creamed on toast²	a. h.	2 h. tbsp.	125	72.81	16.26	66.7	12.62	117.4	21.76	89.2	273	219
Fricasseed	a. h.	1 slice.	100	67.50	17.60	72.2	11.50	107.0	2.40	9.8	189	189
Roast²	a. h.	1 “	100	60.30	32.10	131.6	4.40	40.9	2.10	8.6	181	181
Lamb:												
Chop with bone	a. h.	1 chop.	100	47.60	21.70	89.0	29.90	278.1	......	.....	367	367
Roast	a. h.	1 slice.	75	50.33	14.78	60.6	9.53	88.6	......	.....	150	200

the case of puddings and sauces, only the total weights and values are given, but these can be readily calculated separately if desired by reference to these ingredients in other parts of the table.

The proportion of water in a considerable number of cases is only approximate, being reckoned as the difference between the total weight and the total of the protein, carbohydrates, fats and ash.

TABLE 7.—*Prepared Foods—Edible Portion (Continued)*

FOOD STUFFS.	Portion.	Quantity.	Weight.	Water.	Protein.		Fats.		Carbohydrates.		Total Calories.	Calories per 100 Grams.
			Grams.	Grams.	Grams.	Calories.	Grams.	Calories.	Grams	Calories.		
Mutton:												
Boiled, lean[9]	a. h.	1 slice.	75	47.61	23.18	95.0	3.38	31.4	......	.....	126	168
Chop, lean[9]	a. h.	1 chop.	100	71.80	22.60	92.7	4.50	41.9	......	.....	135	135
Roast leg	a. h.	1 slice.	75	38.18	18.75	76.9	16.95	157.6	......	.....	234	313
Pork:												
Bacon, smoked, uncooked	a. h.	1 slice.	30	6.06	3.15	12.9	19.44	180.8	......	.....	194	646
Chop[9]	a. h.	1 chop.	70	47.18	17.92	73.5	4.20	39.1	......	.....	113	161
Ham, smoked, boiled, as purchased	a. h.	1 slice.	33	0.69	7.29	29.9	6.80	63.2	......	.....	93	291
Ham, smoked, fried	a. h.	1 "	35	12.81	7.77	31.9	11.62	108.1	......	.....	140	400
Roast[2]	a. h.	1 "	100	60.68	28.42	116.5	10.00	93.0	......	.....	210	210
Sausage, uncooked	a. h.	1 sausage.	35	13.93	4.55	18.7	15.47	143.9	0.39	1.6	164	468
Turkey:												
Roast	a. h.	1 slice.	100	52.00	27.80	114.0	18.40	171.1	......	.....	285	285
Veal:												
Calf's-foot jelly	a. h.	1 h. tbsp.	50	38.80	2.15	8.8	......	.....	8.70	35.7	45	89
Cutlet[2]	a. h.	1 cutlet.	80	55.16	22.82	93.6	1.14	10.6	......	.....	104	133
Roast[2]	a. h.	1 slice.	75	51.77	21.33	87.5	1.00	9.3	......	.....	97	132

TABLE 7.—*Prepared Foods—Edible Portion* (*Continued*)

FOOD STUFFS.	Portion.	Quantity.	Weight.	Water.	Protein.		Fats.		Carbohydrates.		Total Calories.	Calories per 100 Grams.
			Grams.	Grams.	Grams.	Calories.	Grams.	Calories.	Grams.	Calories.		
2. FISH.*												
Bluefish	a. h.	....	100	68.20	25.90	106.2	4.50	41.9	......	.....	148	148
Cod[12]	a. h.	....	100	76.32	21.68	88.9	.27	2.5	1.58	6.5	98	98
Haddock[12]	a. h.	....	100	72.37	21.98	90.1	.36	3.3	3.63	14.9	108	108
Halibut[12]	a. h.	....	100	74.46	20.35	83.4	4.04	37.6	......	.....	121	121
Mackerel[12]	a. h.	....	70	51.19	11.73	48.1	4.84	45.0	2.62	10.7	104	148
Salmon[12]	a. h.	....	100	65.32	19.65	80.6	10.21	95.0	5.36	22.0	198	198
Sardines, canned	....	1 fish.	10	5.23	2.30	9.4	1.97	18.3	......	.....	28	278
Smelts[12]	....	1 "	14	11.30	2.23	9.1	.26	2.4	.06	.2	12	85
Spanish mackerel, broiled	a. h.	....	100	63.50	21.80	89.4	5.90	54.9	......	.....	144	144
Sturgeon, Russian caviare.	a. h.	1 h. tsp.	10	3.81	3.00	12.3	1.97	18.3	.76	3.1	34	337
Trout, brook[12]	a. h.	....	50	36.79	10.57	43.3	1.17	10.9	.62	2.5	57	114
Shellfish												
Clams, long	a. h.	6 clams.	150	128.70	12.90	52.9	1.5	14.0	3.00	12.3	79	53
Clams, round	a. h.	6 "	100	86.20	6.50	26.7	.4	3.7	4.20	17.2	47	47

* When not otherwise indicated, the method of cooking is by boiling. Many of the cooked fishes are usually served with a sauce of some kind, but in no instance is the food value of the sauce included unless so specified. This can be easily computed by reference to the section on condiments and sauces given later in the table, and added if desired.

TABLE 7.—*Prepared Foods—Edible Portion (Continued)*

FOOD STUFFS.	Portion.	Quantity.	Weight.	Water.	Protein.		Fats.		Carbo-hydrates.		Total Calories.	Calories per 100 Grams.
			Grams.	Grams.	Grams.	Calories.	Grams.	Calories.	Grams.	Calories.		
Shellfish—Continued.												
Crabs, hard shelled, as purchased	a. h.	1 crab.	245	89.92	19.36	79.4	2.21	20.6	1.47	6.0	106	91
Lobster	a. h.	....	105	83.16	17.22	70.6	1.89	17.6	.42	1.7	90	86
Oysters	a. h.	6 oysters.	85	73.86	5.27	21.6	1.02	9.5	3.15	12.9	44	52
Oysters, creamed, on toast	a. h.	6 oysters on 1 slice toast.	205	148.12	12.57	51.5	16.13	150.0	25.62	105.0	307	150
Oyster stew	a. h.	4 oz.	124	95.00	6.07	24.9	11.06	102.9	10.53	43.2	171	138
Scalloped oysters	a. h.	6 large oysters.	138	97.40	8.06	33.0	18.58	172.8	11.98	49.1	255	185
Scallops, fried	a. h.	3 h. tbsp.	110	154.38	28.20	115.6	1.75	17.3	6.02	24.7	158	144
3. SOUPS.												
Bean, home made	a. h.	4 oz.	120	101.16	3.84	15.7	1.68	15.6	11.28	46.2	78	65
Beef, home made	a. h.	4 "	120	111.48	5.28	21.6	.48	4.5	1.32	5.4	32	26
Bouillon, canned	a. h.	4 "	120	115.92	2.64	10.8	.12	1.1	.24	1.0	13	11
Chicken, home made	a. h.	4 "	120	101.16	12.60	51.7	.96	8.9	2.88	11.8	72	61
Chicken gumbo, canned	a. h.	4 "	120	107.04	4.56	18.7	1.08	10.0	5.64	23.1	52	43
Clam chowder, home made	a. h.	4 "	120	106.44	2.16	8.8	.96	8.9	8.04	33.0	51	43
Consommé, canned	a. h.	4 "	120	115.20	3.00	12.3	......	.....	.48	2.0	14	12

TABLE 7.—*Prepared Foods—Edible Portion* (*Continued*)

FOOD STUFFS.	Portion.	Quantity.	Weight.	Water.	Protein.		Fats.		Carbohydrates.		Total Calories.	Calories per 100 Grams.
			Grams.	Grams.	Grams.	Calories.	Grams.	Calories.	Grams.	Calories.		
Cream soups, home made:												
Asparagus[5]	a. h.	4 oz.	125	104.50	3.44	14.1	8.62	80.2	4.87	20.0	114	92
Celery[5]	a. h.	4 "	125	104.25	3.00	12.3	8.94	83.1	5.01	20.5	116	93
Corn[5]	a. h.	4 "	125	99.34	3.75	15.4	8.70	80.9	10.66	43.7	140	112
Pea[5]	a. h.	4 "	125	92.92	6.29	25.8	8.46	78.7	14.07	57.7	162	130
Potato[5]	a. h.	4 "	125	102.25	2.87	11.8	9.03	84.0	9.60	39.4	135	108
Tomato[5]	a. h.	4 "	125	102.44	2.99	12.3	9.40	87.4	6.36	26.1	126	101
Green turtle, canned	a. h.	4 "	120	103.92	7.32	30.0	2.28	21.2	4.68	19.2	70	58
Julienne, canned	a. h.	4 "	120	115.08	3.24	13.3	......	.....	.6	2.5	16	13
Meat stew, home made	a. h.	....	180	152.10	8.28	33.9	7.74	72.0	9.90	40.6	147	81
Mock turtle, canned	a. h.	4 oz.	120	107.76	6.24	25.6	1.08	10.1	3.36	13.8	50	41
Mulligatawny, canned	a. h.	4 "	120	107.16	4.44	18.2	.12	1.1	6.84	28.0	47	40
Oxtail, canned	a. h.	4 "	120	106.56	4.80	19.7	1.56	14.5	5.16	21.2	55	46
Pea, canned	a. h.	4 "	120	104.28	4.32	17.7	.84	7.8	9.12	37.4	63	52
Tomato, canned	a. h.	4 "	120	108.00	2.16	8.9	1.32	12.3	6.72	27.6	49	41
Vegetable, canned	a. h.	4 "	120	114.84	3.48	14.3	......	.....	.6	2.5	17	14
4. DAIRY PRODUCTS AND EGGS.												
Butter	a. h.	1 ball.	15	1.65	0.15	0.6	12.75	118.6	......	.....	119	795

TABLE 7.—*Prepared Foods—Edible Portion (Continued)*

FOOD STUFFS.	Portion.	Quantity.	Weight.	Water.	Protein.		Fats.		Carbohydrates.		Total Calories.	Calories per 100 Grams.
			Grams.	Grams.	Grams.	Calories.	Grams.	Calories.	Grams.	Calories.		
Cream:												
Average"[10]	a. h.	1 tbsp.	20	13.28	.74	3.0	5.14	47.8	0.71	2.9	54	269
Heavy"[7]	a. h.	1 "	20	11.66	.43	1.8	7.24	67.4	.58	2.4	72	358
"Thick"[8]	a. h.	1 "	20	7.87	.31	1.3	11.22	104.3	.46	1.9	108	540
Whipped[10]	a. h.	1 h. tbsp.	30	17.9	1.11	4.6	7.72	71.8	1.06	4.3	81	269
Cheese:												
American, pale	a. h.	1 cu. in.	20	6.32	5.70	23.6	7.18	66.7	.06	.2	91	453
Camembert[4]	a. h.	1 h. tsp.	20	9.72	4.20	17.2	4.34	40.4	......	.....	58	290
Cheddar	a. h.	1 " "	20	5.48	5.54	23.7	7.36	67.5	.82	3.4	95	473
Cheshire	a. h.	1 " "	20	7.42	5.38	22.1	6.14	57.1	.18	.7	80	399
Dutch	a. h.	2 scoops.	20	7.04	7.42	30.4	3.54	32.9	......	.....	63	316
Fromage de Brie	a. h.	1 cu. in.	20	12.04	3.18	13.0	4.20	39.1	.28	1.2	53	267
Full cream	a. h.	1 " "	20	6.84	5.18	21.2	6.74	62.7	.48	2.0	86	430
Limburger	a. h.	1 " "	20	8.42	4.60	18.9	5.88	54.7	.08	.3	74	369
Neuchatel	a. h.	1 " "	20	10.00	3.74	15.3	5.48	51.0	.30	1.2	68	337
Pineapple	a. h.	2 scoops.	20	4.60	5.98	24.5	7.78	72.4	.52	2.1	99	495
Roquefort	a. h.	1 cu. in.	20	7.86	4.52	18.5	5.90	54.9	.36	1.5	75	375
Stilton[4]	a. h.	2 scoops.	20	5.52	4.78	19.6	7.78	72.4	......	.....	92	460
Swiss	a. h.	1 slice.	20	6.28	5.52	22.6	6.98	64.9	.26	1.1	89	443
Koumiss	a. h.	wineglass.	130	116.09	3.64	14.9	2.73	25.4	7.02	28.7	69	53

TABLE 7.—*Prepared Foods—Edible Portion (Continued)*

FOOD STUFFS.	Portion.	Quantity.	Weight.	Water.	Protein.		Fats.		Carbo-hydrates.		Total Calories.	Calories per 100 Grams.
			Grams.	Grams.	Grams.	Calories.	Grams.	Calories.	Grams.	Calories.		
Milk:												
Buttermilk	a. h.	1 glass.	218	198.38	6.54	26.8	1.09	10.1	10.46	42.9	80	36
Condensed milk, sweetened	a. h.	1 tbsp.	26	6.99	2.28	9.4	2.16	20.0	14.07	57.7	87	335
Condensed milk, unsweetened (evaporated cream)	a. h.	1 tbsp.	20	13.64	1.92	7.9	1.86	17.3	2.24	9.2	34	172
Skimmed milk	a. h.	1 glass.	222	200.91	7.55	31.0	.67	6.2	11.32	46.4	84	37
Whole milk	a. h.	1 "	220	191.40	7.26	29.8	8.80	81.8	11.00	45.1	157	72
Whey	a. h.	1 "	203	188.79	2.03	8.3	.61	5.7	10.15	41.6	56	28
Eggs:												
Hens', boiled	a. h.	1 egg.	50	36.60	6.60	27.1	6.00	55.8	......	.....	83	169
Hens', uncooked	a. h.	1 "	50	36.85	6.70	27.5	5.25	48.8	......	.....	76	159
Hens', whites, boiled	....	1 "	32	27.58	4.16	17.1	.06	.6	......	.....	18	55
Hens', yolks, boiled	....	1 "	18	8.91	2.89	11.8	5.99	55.7	......	.....	68	376
Omelette	a. h.	½ omelette.	75	48.57	9.80	40.2	14.01	130.3	1.55	6.4	177	236
Ingredients:												
3 tbsp. milk.												
3 eggs.												
1 h. tsp. butter.												

TABLE 7.—*Prepared Foods—Edible Portion (Continued)*

FOOD STUFFS.	Portion.	Quantity.	Weight.	Water.	Protein.		Fats.		Carbo-hydrates.		Total Calories.	Calories per 100 Grams.
			Grams.	Grams.	Grams.	Calories.	Grams.	Calories.	Grams.	Calories.		
5. VEGETABLES.												
Artichokes, French[4]	a. h.	1 artichoke.	360	329.80	6.48	26.6	.29	2.7	16.56	67.9	97	27
Asparagus, canned	a. h.	....	125	118.00	1.88	7.7	.13	1.2	3.50	14.4	23	19
Beans:												
Baked, home made	a. h.	3 h. tbsp.	150	91.17	10.83	44.4	12.76	118.7	32.84	134.6	298	199
Baked, canned	a. h.	3 " "	115	79.24	7.94	32.6	2.88	26.8	22.54	92.4	152	132
Butter[5]	a. h.	4 " "	80	62.78	3.78	15.5	.24	2.2	11.60	47.6	65	81
Lima[5]	a. h.	2 " "	80	48.10	6.40	26.2	.54	5.0	23.60	96.8	128	160
Red kidney, canned	a. h.	2 " "	70	50.89	4.90	20.1	.14	1.3	12.95	53.1	75	106
String	a. h.	2 " "	60	57.18	.48	2.0	.66	6.1	1.14	4.7	13	21
Beets	a. h.	2 " "	70	62.02	1.61	6.6	.07	.7	5.18	21.2	29	41
Beet greens	a. h.	2 " "	100	89.50	2.20	9.0	3.40	31.6	3.20	13.1	54	54
Cabbage[4]	a. h.	3 " "	100	97.40	.60	2.5	.10	.9	.40	1.6	5	5
Carrots[4]	a. h.	3 " "	100	93.40	.53	2.2	.17	1.6	3.39	13.9	18	18
Cauliflower[12]	a. h.	2 " "	120	117.48	1.08	4.4	.12	1.1	.48	2.0	8	7
Celery, creamed[4]	a. h.	3 " "	90	78.90	1.42	5.8	4.98	46.3	3.46	14.2	66	73
Celery, uncooked	a. h.	3 small stalks.	55	41.60	.50	2.1	.05	.5	1.43	5.9	8	19
Corn, canned	a. h.	2 h. tbsp.	100	76.10	2.80	11.5	1.20	11.2	19.00	77.9	101	101
Corn, green[5]	a. h.	1 ear.	100	76.25	3.07	12.6	1.10	10.2	18.78	77.0	100	100
Cucumber, uncooked	a. h.	8 thin slices.	50	47.70	.40	1.6	.10	.9	1.55	6.4	9	18
Dandelion greens[5]	a. h.	2 h. tbsp.	100	81.40	2.39	9.8	1.01	9.4	10.67	43.8	63	63

TABLE 7.—*Prepared Foods—Edible Portion* (*Continued*)

FOOD STUFFS.	Portion.	Quantity.	Weight. Grams.	Water. Grams.	Protein.		Fats.		Carbohydrates.		Total Calories.	Calories per 100 Grams.
					Grams.	Calories.	Grams	Calories.	Grams.	Calories.		
Mushrooms, broiled	a. h.	2 large on toast.	57	30.58	3.52	14.4	8.94	83.1	12.85	52.7	150	263
Mushrooms, uncooked	....	2 large.	45	39.65	1.58	6.5	.18	1.7	3.06	12.5	21	46
Onions	a. h.	1 onion.	100	91.20	1.20	4.9	1.80	16.7	4.90	20.1	42	42
Parsnips[4]	a. h.	4 slices.	100	97.28	.22	.9	.29	2.7	1.46	6.0	10	10
Peas, green	a. h.	3 h. tbsp.	92	67.90	6.16	25.3	3.13	29.1	13.43	55.1	110	119
Potatoes, sweet, boiled	a. h.	a. size.	100	51.90	3.00	12.3	2.10	19.5	42.1	172.6	204	204
Potatoes, white:												
Baked[5]	a. h.	m. size.	130	90.87	3.77	15.5	.20	1.9	32.07	131.5	149	114
Boiled	a. h.	" "	150	113.25	3.75	15.4	.15	1.4	31.35	128.5	145	97
Chips	a. h.	3 h. tbsp.	50	1.10	3.40	13.9	19.90	185.1	23.35	95.7	295	589
Creamed	a. h.	4 " "	115	85.79	3.61	14.8	5.17	48.1	19.07	78.2	141	123
Mashed and creamed	a. h.	2 " "	100	75.10	2.60	10.7	3.00	27.9	17.80	73.0	112	112
Squash[5]	a. h.	2 " "	100	83.62	1.36	5.6	.82	7.6	13.60	55.8	69	69
Spinach	a. h.	2 " "	100	89.80	2.10	8.6	4.10	38.1	2.60	10.7	57	57
Tomatoes, canned	a. h.	2 " "	70	65.80	.84	3.4	.14	1.3	2.80	1.4	16	23
Tomatoes, uncooked	a. h.	m. size.	200	188.00	2.40	9.8	.40	3.7	8.00	32.8	46	23
Turnips[4]	a. h.	2 h. tbsp.	140	136.15	.45	1.8	.08	.7	.91	3.7	6	4

TABLE 7.—*Prepared Foods—Edible Portion* (*Continued*)

FOOD STUFFS.	Portion.	Quantity.	Weight.	Water.	Protein.		Fats.		Carbohydrates.		Total Calories.	Calories per 100 Grams.
			Grams.	Grams.	Grams.	Calories.	Grams.	Calories.	Grams.	Calories.		
6. FRUITS.												
A. *Fresh*, as purchased:												
Apple	a. h.	a. size.	150	94.95	.45	1.8	.45	4.2	16.20	66.4	72	49
Banana	a. h.	a. "	194	94.86	1.55	6.4	.78	7.3	27.74	113.7	127	66
Blackberries	a. h.	3 h. tbsp.	100	86.30	1.30	5.3	1.00	9.3	10.90	44.7	59	59
Cantaloupe	a. h.	½ melon.	465	232.50	1.40	5.7	......	.....	21.39	87.7	93	20
Cherries	a. h.	About ¼ lb.	100	76.80	.90	3.7	.80	7.4	15.90	65.2	76	76
Currants	a. h.	4 h. tbsp.	100	85.00	1.50	6.2	......	.....	12.80	52.5	59	59
Grapefruit[3]	a. h.	½ large.	300	......	2.37	9.7	.60	5.6	30.27	124.1	139	46
Grapes	a. h.	1 bunch.	150	87.00	1.50	6.2	1.80	16.7	21.60	88.6	112	74
Gooseberries[6]	a. h.	4 h. tbsp.	90	77.04	.90	3.7	......	.....	11.79	48.3	52	56
Huckleberries	a. h.	4 " "	100	81.90	.60	2.5	.60	5.6	16.60	68.1	76	76
Lemon	....	a. size.	130	81.25	.91	3.7	.65	6.0	7.67	31.4	41	32
Orange	a. h.	a. "	250	158.50	1.50	6.2	.25	2.3	21.25	87.1	96	37
Peach	a. h.	a. "	128	93.82	.64	2.6	.13	1.2	9.86	40.4	44	34
Pear	a. h.	a. "	156	118.56	.78	3.2	.62	5.8	19.81	81.2	90	57
Pineapple, edible portion	a. h.	2 slices.	100	89.30	.40	1.6	.30	2.8	9.70	39.8	44	44
Plum	a. h.	a. size.	35	26.07	.32	1.3	......	.....	6.69	27.4	29	81
Raspberries	a. h.	3 h. tbsp.	82	70.36	.82	3.4	......	.....	10.33	42.3	46	56
Strawberries	a. h.	4 " "	100	90.40	1.00	4.1	.60	5.6	7.40	30.3	40	40
Watermelon	a. h.	Large slice.	300	112.50	.60	2.5	.30	2.8	8.10	33.2	39	13

TABLE 7.—*Prepared Foods—Edible Portion (Continued)*

FOOD STUFFS.	Portion.	Quantity.	Weight.	Water.	Protein.		Fats.		Carbohydrates.		Total Calories.	Calories per 100 Grams.
			Grams.	Grams.	Grams.	Calories.	Grams.	Calories.	Grams.	Calories.		
B. *Dried*, as purchased:												
Apricots	....	10 large.	80	23.52	3.76	15.4	.80	7.4	50.00	205.0	228	284
Dates	....	10 "	83	11.45	1.58	6.5	2.08	19.3	58.60	240.3	266	320
Figs	....	10 "	117	36.66	8.38	34.4	.58	5.4	144.69	592.8	633	325
Prunes	....	10 very large.	200	38.00	3.60	14.8	......	.....	124.40	510.0	525	262
Raisins	....	10 " "	25	3.28	.57	2.3	.75	7.0	17.13	70.2	80	318
C. *Stewed, Jellies, etc.*:*												
Apple, baked[5]	a. h.	1 large.	120	88.67	.61	2.5	.58	5.4	29.30	120.1	128	107
Apple sauce	a. h.	3 h. tbsp.	125	76.38	.25	1.0	1.00	9.3	46.50	190.7	201	161
Apricot sauce	a. h.	3 " "	112	50.62	2.13	8.7	1.46	13.6	54.66	224.1	246	220
Cranberries, stewed	a. h.	2 h. tbsp.	100	60.70	0.27	1.1	0.41	3.8	36.00	147.6	153	153
Currant jelly[5]	a. h.	1 " "	35	7.23	.36	1.5	......	.....	27.16	111.4	113	323
Figs, stewed	a. h.	3 figs.	125	70.62	1.50	6.2	.38	3.5	51.13	209.6	219	173
Marmalade, orange	a. h.	1 h. tbsp.	30	4.35	.18	.7	.03	.3	25.35	103.9	105	349
Prune sauce	a. h.	4 very large and juice.	200	153.20	1.00	4.1	.20	1.9	44.60	182.9	189	95
Rhubarb, stewed	a. h.	2 h. tbsp.	90	56.26	.40	1.6	47	4.4	32.40	132.8	139	154

* Sugar used in preparation of the stewed fruits and jellies is included in the calculations.

TABLE 7.—*Prepared Foods—Edible Portion (Continued)*

FOOD STUFFS.	Portion.	Quantity.	Weight.	Water.	Protein.		Fats.		Carbo-hydrates.		Total Calories.	Calories per 100 Grams.
			Grams.	Grams.	Grams.	Calor-ies.	Grams.	Calor-ies.	Grams.	Calor-ies.		
7. BREAD, CRACKERS, ETC.												
A. *Bread:*												
Brown, baker's......	1 slice.	4x4x½ in.	80	34.88	4.32	17.7	1.44	13.4	37.68	154.5	186	231
Corn (johnnycake)...	1 "	3x2x¾ "	39	15.17	3.08	12.6	1.83	17.0	18.06	74.1	104	266
Rye...............	1 "	3½x3x½ in.	39	13.92	3.51	14.4	.23	2.1	20.74	85.0	102	260
Wheat:												
Buns, cinnamon...	1 bun.	....	45	10.62	4.23	17.3	3.24	30.1	26.59	109.0	156	347
Buns, currant.....	1 "	....	50	13.75	3.35	13.7	3.80	35.3	28.80	118.1	167	334
Gluten...........	1 slice.	3½x2¾x½ in.	39	14.90	3.63	14.9	.55	5.1	19.42	79.6	100	256
Graham..........	1 "	3¾x2¾x½ "	37	13.21	3.29	13.5	.67	6.2	19.28	79.1	99	267
Biscuits, home made	1 biscuit.	....	35	11.52	3.05	12.5	.91	8.5	19.36	79.4	100	287
Biscuits, soda.....	1 "	....	38	8.70	3.53	14.5	5.21	48.5	19.99	82.0	145	381
Rolls, French.....	1 roll.	....	39	12.48	3.32	13.6	.98	9.1	21.72	89.1	112	287
Rolls, Vienna.....	1 "	....	45	14.27	3.83	15.7	.99	9.2	25.43	104.3	129	287
Toasted..........	½ slice.	4x2x¼ in.	10	2.40	1.15	4.7	.16	1.5	6.12	25.1	31	313
White, baker's....	1 "	3½x3x½ in.	30	10.59	2.76	11.3	.39	3.6	15.93	65.3	80	268
White, home made.	1 "	3x4x½ in.	37	12.95	3.37	13.8	.59	5.5	19.72	80.9	100	270
Whole wheat.....	1 "	3½x3½x½ in.	42	16.13	4.07	16.7	.38	3.5	20.87	85.6	106	251
Zwieback........	1 "	3½x2x½ in.	15	.87	1.47	6.0	1.49	13.9	11.03	45.2	65	434

TABLE 7.—*Prepared Foods—Edible Portion (Continued)*

FOOD STUFFS.	Portion.	Quantity.	Weight.	Water.	Protein.		Fats.		Carbo-hydrates.		Total Calories.	Calories per 100 Grams.
			Grams.	Grams.	Grams.	Calories.	Grams.	Calories.	Grams.	Calories.		
B. *Crackers:*												
Boston (split)	1 cracker	d. 2 in.	10	.75	1.10	4.5	.85	7.9	7.11	29.2	42	416
Butter	1 "	d. 2 "	4	.29	.38	1.6	.40	3.7	2.86	11.7	17	427
Cream lunch	1 "	d. 3 "	13	.88	1.26	5.2	1.57	14.6	9.06	37.2	57	439
Graham	1 "	3 in. sq.	8	.43	.80	3.3	.75	7.0	5.9	24.2	34	429
Oatmeal	1 "	3 " "	10	.63	1.18	4.8	1.11	10.3	6.90	28.3	43	434
Oyster	10 cr'k'rs	d. 1 in.	11	.53	1.24	5.1	1.16	10.8	7.76	31.8	48	433
Pilot bread	1 cracker	d. 5 "	33	2.87	3.66	15.0	1.65	15.4	24.49	100.4	131	397
Pretzels	1 "	....	6	.58	.58	2.4	.23	2.1	4.37	17.9	22	375
Saltines	1 "	2 in. sq.	3	.17	.32	1.3	.38	3.5	2.06	8.4	13	492
Soda:												
Educators	1 "	2 " "	3	.08	.97	4.0	......	.....	1.39	5.7	10	333
Uneeda biscuits	1 "	3 " "	6	.35	.59	2.4	.55	5.1	4.38	17.7	25	424
Zephyrs	1 "	3½ in. sq.	10	.59	.98	4.0	.91	8.5	7.31	30.0	43	424
C. *Sandwiches:*												
Chicken	a. h.	1 sandwich.	70	33.95	8.61	35.3	3.78	35.2	22.47	92.1	163	232
Egg	a. h.	1 "	100	41.40	9.60	39.4	12.70	118.1	34.50	141.5	299	299
Ham	a. h.	1 "	70	24.15	7.28	29.8	10.07	93.7	26.65	109.3	233	332

TABLE 7.—*Prepared Foods—Edible Portion* (*Continued*)

FOOD STUFFS.	Portion.	Quantity.	Weight.	Water.	Protein.		Fats.		Carbo-hydrates.		Total Calories.	Calories per 100 Grams.
			Grams.	Grams.	Grams.	Calor-ies.	Grams.	Calor-ies.	Grams.	Calor-ies.		
8. BREAKFAST FOODS, MILK GRUELS, ETC.*												
Cream toast	a. h.	2 slices.	136	71.28	9.03	37.0	14.60	135.8	37.15	152.3	325	238
Ingredients:												
2 slices toast.												
5 tbsp. cream sauce.												
Farina	a. h.	2 h. tbsp.	100	86.63	1.65	6.8	.21	2.0	11.45	47.0	56	56
Force[4]	a. h.	5 " "	18	1.67	1.70	7.0	.24	2.2	13.87	56.9	66	367
Grapenuts[4]	a. h.	5 " "	65	4.02	7.78	31.9	.40	3.7	51.51	211.2	247	380
Gruels (milk):												
Arrowroot	a. h.	4 h. tbsp.	200	155.78	8.25	33.8	10.00	93.0	24.20	99.2	226	113
Ingredients:												
1 tbsp. arrowroot.												
1 c. milk.												
Barley	a. h.	4 " "	120	93.12	5.94	24.4	6.41	59.6	13.25	54.3	138	115
Ingredients:												
1 tbsp. barley flour.												
1¼ c. milk.												

* The sugar, milk or cream, with which any of this group may be served, is not considered and their caloric value must therefore be added when used.

TABLE 7.—*Prepared Foods—Edible Portion* (*Continued*)

FOOD STUFFS.	Portion.	Quantity.	Weight.	Water.	Protein.		Fats.		Carbo-hydrates.		Total Calories.	Calories per 100 Grams.
			Grams.	Grams.	Grams.	Calor-ies.	Grams.	Calor-ies.	Grams.	Calor-ies.		
Gruels (milk)—Continued.												
Cornmeal............	a. h.	4 h. tbsp.	115	96.76	3.85	15.8	4.11	38.2	9.52	39.0	93	81
Ingredients: 2 tbsp. white corn-meal. 2 c. milk.												
Oatmeal............	a. h.	2 " "	100	59.81	8.72	35.8	8.10	75.3	21.83	89.5	201	201
Ingredients: 3 tbsp. oatmeal. 2 c. milk.												
Hominy, boiled.........	a. h.	2 " "	100	79.30	2.20	9.0	.20	1.9	17.80	73.0	84	84
H-O, boiled[4]...........	a. h.	2 " "	100	84.07	2.42	9.9	1.45	13.5	11.76	48.2	72	72
Indian meal mush.......	a. h.	3 " "	115	92.90	2.10	8.6	1.18	11.0	18.50	75.9	96	83
Macaroni, boiled........	a. h.	2 " "	100	78.40	3.00	12.3	1.50	14.0	15.80	64.8	91	91
Macaroni, baked with cheese...............	a. h.	2 " "	140	54.42	19.06	78.1	20.46	190.3	43.44	178.1	447	319
Oatmeal, boiled.........	a. h.	2 " "	100	84.50	2.80	11.5	.50	4.7	11.50	47.2	63	63
Puffed rice[13]...........	a. h.	5 " "	14	.99	.87	3.6	.08	.7	12.00	49.2	54	361
Rice, boiled............	a. h.	1 " "	100	72.50	2.80	11.5	.10	.9	24.40	100.0	112	112
Shredded wheat biscuit...	a. h.	1 biscuit.	29	2.35	3.05	12.5	.41	3.8	22.59	92.6	109	375

TABLE 7.—*Prepared Foods—Edible Portion* (*Continued*)

FOOD STUFFS.	Portion.	Quantity	Weight.	Water.	Protein.		Fats.		Carbohydrates.		Total Calories.	Calories per 100 Grams.
			Grams.	Grams.	Grams.	Calories.	Grams.	Calories.	Grams.	Calories.		
Spaghetti, baked with tomato	a. h.	3 h. tbsp.	145	111.21	4.52	18.5	2.81	26.1	25.76	105.6	150	103
Vermicelli, boiled	a. h.	2 " "	100	88.43	1.42	5.8	.26	2.4	9.36	38.4	47	47
Wheat germ, boiled	a. h.	2 " "	100	84.77	1.79	7.3	.34	3.2	12.92	53.0	64	64
9. CAKES, PASTRY, PUDDINGS, ETC.												
A. *Cakes:*												
Chocolate layer	a. h.	....	70	14.30	4.34	17.8	5.67	52.7	44.87	184.0	255	364
Frosted	1 slice.	1x1½x3 in.	40	7.28	2.36	9.7	3.60	33.5	25.92	106.1	149	374
Fruit	1 "	2¾x2¾x½ in.	44	7.61	2.60	10.7	4.80	44.6	28.20	115.6	171	388
Gingerbread	1 "	2x3x1 in.	60	11.28	3.48	14.3	5.40	50.2	38.10	156.2	221	368
Sponge	1 "	2x3½x½ in.	23	3.52	1.45	6.0	2.46	22.9	15.16	62.2	91	396
B. *Pastry:*												
Pie:												
Apple	a. h.	⅙ pie.	126	53.55	3.91	16.0	12.35	114.9	53.93	221.1	352	280
Cream	a. h.	⅙ "	126	40.32	5.54	22.7	14.36	133.6	64.51	264.5	421	334
Custard	a. h.	⅙ "	133	82.99	5.59	23.0	8.38	77.9	34.71	142.3	243	183
Lemon	a. h.	⅙ "	110	52.14	3.96	16.2	11.11	103.3	41.14	168.7	288	262

TABLE 7.—*Prepared Foods—Edible Portion* (*Continued*)

FOOD STUFFS.	Portion.	Quantity.	Weight.	Water.	Protein.		Fats.		Carbo-hydrates.		Total Calories.	Calories per 100 Grams.
			Grams.	Grams.	Grams.	Calor-ies.	Grams.	Calor-ies.	Grams.	Calor-ies.		
Pie—Continued.												
Mince	a. h.	⅙ pie.	113	46.67	6.55	26.9	13.90	129.3	43.05	176.5	333	294
Squash	a. h.	⅙ "	133	83.39	5.85	24.0	11.17	103.9	28.86	118.3	246	185
C. *Puddings:*												
Bread pudding	a. h.	2 h. tbsp.	105	55.00	5.52	22.6	4.79	44.6	38.48	157.8	225	214
Ingredients:												
1 c. bread crumbs.												
1 c. milk.												
1 egg.												
½ c. sugar.												
¼ c. raisins.												
Chocolate pudding	a. h.	2 " "	95	53.45	4.99	20.5	7.90	73.5	27.83	114.1	208	219
Ingredients:												
1 oz. chocolate.												
2 h. tbsp. sugar.												
1½ tbsp. cornstarch.												
1 c. milk.												
White 1 egg.												

TABLE 7.—*Prepared Foods—Edible Portion* (*Continued*)

FOOD STUFFS.	Portion.	Quantity.	Weight.	Water.	Protein.		Fats.		Carbo-hydrates.		Total Calories.	Calories per 100 Grams.
			Grams.	Grams.	Grams.	Calor-ies.	Grams.	Calor-ies.	Grams.	Calor-ies.		
C. *Puddings*—Continued.												
Custard puddings:												
Baked custard. . . . Ingredients: 2 c. milk. 2 eggs. ¼ c. sugar.	a. h.	2 h. tbsp.	134	97.65	7.31	30.0	7.42	68.8	20.50	84.1	183	136
Chocolate custard. Ingredients: 1 h. tsp. grated chocolate. 1 c. milk. 1 egg. 1 h. tbsp. sugar.	a. h.	2 " "	120	82.92	8.12	33.3	10.06	93.6	17.75	72.8	200	167
Rice custard. . . . . . Ingredients: 1 c. boiled rice. 2 eggs. 1½ c. milk. 2 h. tbsp. sugar.	a. h.	2 " "	110	71.90	6.46	26.2	5.04	46.5	25.80	105.8	179	163

TABLE 7.—*Prepared Foods—Edible Portion* (*Continued*)

FOOD STUFFS.	Portion.	Quantity.	Weight.	Water.	Protein.		Fats.		Carbo-hydrates.		Total Calories.	Calories per 100 Grams.
			Grams.	Grams.	Grams.	Calories.	Grams.	Calories.	Grams.	Calories.		
C. *Puddings*—Continued.												
Soft custard. . . .	a. h.	4 tbsp.	60	36.01	4.39	18.0	6.84	63.7	12.12	49.7	131	219
Ingredients:												
Yolk 1 egg.												
½ c. milk.												
1 h. tbsp. sugar												
Indian meal pudding	a. h.	2 h. tbsp	164	95.16	9.02	37.0	10.16	93.9	47.02	192.8	324	197
Ingredients:												
3 c. milk.												
3 h. tsp. Indian meal.												
½ c. molasses.												
1 h. tbsp. butter.												
1 " " sugar.												
Snow pudding.	a. h.	2 " "	80	63.59	4.52	18.5	.03	.3	11.73	48.1	67	84
Ingredients:												
¾ c. water.												
1 h. tsp. gelatin.												
2 h. tbsp. sugar.												
1 tsp. lemon juice.												
Lemon rind.												
White 1 egg.												

Table 7.—*Prepared Foods—Edible Portion* (*Continued*)

Food Stuffs	Portion.	Quantity.	Weight.	Water.	Protein.		Fats.		Carbo-hydrates.		Total Calories.	Calories per 100 Grams.
			Grams.	Grams.	Grams.	Calories.	Grams.	Calories.	Grams.	Calories.		
C. *Puddings*—Continued.												
Tapioca pudding....	a. h.	3 h. tbsp.	110	74.81	5.85	23.8	6.12	56.7	22.25	91.2	172	156
Ingredients: 2 c. milk. 1 egg. 3 tbsp. tapioca. 2 " sugar.												
Tapioca and apples..	a. h.	2 " "	100	70.86	.21	.9	.22	2.1	28.58	116.9	120	120
Ingredients: 9 small apples. 1 c. sugar. 1 lemon. ⅔ c. tapioca. 2 c. water.												
D. *Miscellaneous.*												
Banana, peeled, baked with 1 h. tsp. sugar.	a. h.	1 banana.	100	65.30	1.30	5.3	.60	5.6	32.00	131.2	142	142
Banana, baked in skin.	a. h.	1 "	125	96.82	1.40	5.7	.70	6.5	25.03	102.6	115	92

TABLE 7.—*Prepared Foods—Edible Portion* (*Continued*)

FOOD STUFFS.	Portion.	Quantity.	Weight.	Water.	Protein.		Fats.		Carbohydrates.		Total Calories.	Calories per 100 Grams.
			Grams.	Grams.	Grams.	Calories.	Grams.	Calories.	Grams.	Calories.		
D. *Miscellaneous* — Continued.												
Blanc Mange I	a. h.	2 h. tbsp.	90	62.81	4.76	19.5	4.91	45.7	16.83	69.0	134	149
Ingredients: 1 h. tbsp. cornstarch. 1 h. tbsp. sugar. 1 egg. 1 c. milk. 1 tbsp. sherry.												
Blanc Mange II.	a. h.	2 " "	100	85.70	3.63	14.9	4.40	40.9	5.50	22.6	78	78
Ingredients: ¼ c. Irish moss. 2 c. milk. Served or cooked with 1 tbsp. cream. 1 h. tsp. sugar.												
Doughnuts.	1 doughnut.	d. 3½ in.	37	6.77	2.48	10.2	7.77	72.5	19.65	80.6	163	441

TABLE 7.—*Prepared Foods—Edible Portion (Continued)*

FOOD STUFFS.	Portion.	Quantity.	Weight.	Water.	Protein.		Fats.		Carbo-hydrates.		Total Calories.	Calories per 100 Grams.
			Grams.	Grams.	Grams.	Calor-ies.	Grams.	Calor-ies.	Grams.	Calor-ies.		
D. *Miscellaneous* — Continued.												
Egg soufflé.........	a. h.	½ soufflé.	50	.....	5.22	21.4	4.09	38.0	38.09	156.2	216	432
Ingredients: 2 eggs. ½ c. sugar. 1tbsp.lemon juice												
Floating island......	a. h.	3 h. tbsp.	80	55.28	7.48	30.7	7.62	70.9	13.50	55.4	157	196
Ingredients: ½tsp.cornstarch. 1 h. tsp. sugar. 1 egg. 1 c. milk.												
Ginger snaps.......	1 ginger snap.	d. 2¼ in.	5	.32	.33	1.4	.43	4.0	3.80	15.6	21	418
Ice cream	a. h.	2 h. tbsp.	100	66.09	5.21	21.4	10.16	94.5	17.73	72.7	189	189
Ingredients: 3 c. milk. 1 c. cream. 3 eggs. ⅔ c. sugar. Vanilla.												

TABLE 7.—*Prepared Foods—Edible Portion* (*Continued*)

FOOD STUFFS.	Portion.	Quantity.	Weight.	Water.	Protein.		Fats.		Carbohydrates.		Total Calories.	Calories per 100 Grams.
			Grams.	Grams.	Grams.	Calories.	Grams.	Calories.	Grams.	Calories.		
D. *Miscellaneous* — Continued.												
Ladyfingers.	1.	4 in.	20	3.00	1.76	7.2	1.00	9.3	14.12	57.9	74	371
Macaroons.	1.	d. 2½ in.	10	1.23	.65	2.7	1.52	14.1	6.52	26.7	44	435
Molasses cookies. . . .	1 cooky.	4x3.in.	20	1.24	1.44	5.9	1.74	16.2	15.14	62.1	84	421
Orange ice.	a. h.	2 h. tbsp.	100	23.57	.94	3.9	.23	2.1	74.68	306.2	312	312
Ingredients:												
2½ c. orange juice.												
¼ c. lemon juice.												
1½ c. sugar.												
1 c. water.												
Rind 2 oranges.												
Prune soufflé.	a. h.	2 h. tbsp.	85	61.53	3.31	13.6	.65	6.0	18.95	77.7	97	114
Ingredients:												
½ c. stewed prunes (edible portion).												
White 1 egg.												
Sugar cookies.	1 cooky.	d. 3 in.	11	.91	.77	3.2	1.12	10.4	8.05	33.0	47	423

TABLE 7.—*Prepared Foods—Edible Portion (Continued)*

FOOD STUFFS.	Portion.	Quantity.	Weight.	Water.	Protein.		Fats.		Carbohydrates.		Total Calories.	Calories per 100 Grams.
			Grams.	Grams.	Grams.	Calories.	Grams.	Calories.	Grams.	Calories.		
D. *Miscellaneous* — Continued.												
Sugar cookies, home made.	1 cooky.	d. 2½ in.	5	.42	.35	1.4	.51	4.7	3.66	15.0	21	423
Spanish cream	a. h.	2 h. tbsp.	100	58.47	11.71	48.0	7.36	68.5	21.25	87.1	204	204
Ingredients: 1 h. tsp. gelatin. 2 h. tbsp. sugar. 1 c. milk. 1 egg. 1 tbsp. sherry.												
10. CONDIMENTS AND SAUCES.												
Caramel sauce.	a. h.	2 tbsp.	40	15.00	. . . . . .	. . . . . .	. . . . . .	. . . . .	25.00	102.5	103	258
Ingredients: ½ c. sugar. ½ c. water.												

TABLE 7.—*Prepared Foods—Edible Portion (Continued)*

FOOD STUFFS.	Portion.	Quantity.	Weight.	Water.	Protein.		Fats.		Carbo-hydrates.		Total Calories.	Calories per 100 Grams.
			Grams.	Grams.	Grams.	Calories.	Grams.	Calories.	Grams.	Calories.		
Catsup, tomato..........	a. h.	1 tbsp.	20	16.56	.30	1.2	.04	.4	2.46	10.1	12	58
Chaud eau.............	a. h.	2 “	40	5.47	.01	.1	1.13	10.5	33.33	136.8	147	365
Ingredients: 1 c. sugar. 1 h. tsp. butter. ⅓ c. water. Lemon juice.												
Cream sauce...........	a. h.	3 “]	45	31.18	1.87	7.7	6.94	64.5	4.50	18.5	91	202
Ingredients: 1½ c. milk. 2 h. tbsp. flour. 2 “ “ butter.												
French dressing.........	a. h.	1 dsp.	11	4.00	......	.....	8.00	74.4	......	.....	74	673
Ingredients: 4 tbsp. olive oil. 1 “ vinegar. ¼ tsp. salt. Pepper.												

TABLE 7.—*Prepared Foods—Edible Portion (Continued)*

FOOD STUFFS.	Portion.	Quantity.	Weight.	Water.	Protein.		Fats.		Carbohydrates.		Total Calories.	Calories per 100 Grams.
			Grams.	Grams.	Grams.	Calories.	Grams.	Calories.	Grams.	Calories.		
Hollandaise sauce....... Ingredients: ½ c. butter. Yolks 2 eggs. 1 tsp. lemon juice. Salt, cayenne pepper.	a. h.	2 tbsp.	40	18.65	1.85	7.6	17.37	161.5	.32	1.3	170	425
Mayonnaise dressing..... Ingredients: 2 eggs. 2 c. olive oil. 1 tbsp. vinegar, or 1 " lemon juice. Salt, pepper, mustard.	a. h.	1 "	21	.84	.26	1.1	19.92	185.3	.05	.2	187	890
Olive oil..............	....	1 "	13	......	......	.....	13.00	120.9	......	.....	121	930
Olives, green...........	....	1 large.	9	3.80	.07	.3	1.82	16.9	.77	3.2	20	226
Wine sauce............. Ingredients: 1 egg. ½ c. sugar. 3 tbsp. milk. 2 " sherry.	a. h.	3 tbsp.	40	17.79	1.43	5.9	1.24	11.5	19.42	79.6	97	243

TABLE 7.—*Prepared Foods—Edible Portion* (*Continued*)

FOOD STUFFS.	Portion.	Quantity.	Weight.	Water.	Protein.		Fats.		Carbohydrates.		Total Calories.	Calories per 100 Grams.
			Grams.	Grams.	Grams.	Calories.	Grams.	Calories.	Grams.	Calories.		
11. MISCELLANEOUS SWEETS.												
Honey	....	1 tbsp.	30	5.46	.12	.5	.....	.....	24.36	100.0	101	335
Maple syrup	....	1 "	30	.....	.....	.....	.....	.....	21.40	87.9	88	293
Sugar:												
Cube	....	1 cube.	7	.....	.....	.....	.....	.....	7.00	28.7	29	410
Domino	....	1 domino.	6	.....	.....	.....	.....	.....	6.00	24.6	25	410
Granulated	....	1 h. tsp.	10	.....	.....	.....	.....	.....	10.00	41.0	41	410
Powdered	....	1 " "	12	.....	.....	.....	.....	.....	12.00	49.2	49	410
Maple	....	1 cake.	100	.....	.....	.....	.....	.....	82.80	339.4	339	339
12. NUTS.												
Almonds	....	10 large.	15	.72	3.15	12.9	8.23	76.5	2.60	10.7	100	668
Brazil nuts	....	10 "	60	3.18	10.20	41.8	40.08	372.7	4.20	17.2	432	720
Chestnuts, roasted, as purchased	Handful	20 nuts.	50	18.90	2.60	10.7	2.25	20.9	17.70	72.6	104	208
Cocoanut	1 slice.	2x2x½ in.	34	4.79	1.94	8.0	17.20	160.0	9.49	38.9	207	608
Filberts	....	10 nuts.	10	.37	1.56	6.4	6.53	60.7	1.30	5.3	72	725
Peanuts, as purchased	Handful	15 "	30	2.07	5.85	24.0	8.73	81.2	5.55	22.8	128	427

TABLE 7.—*Prepared Foods—Edible Portion (Continued)*

FOOD STUFFS.	Portion.	Quantity.	Weight.	Water.	Protein.		Fats.		Carbohydrates.		Total Calories.	Calories per 100 Grams.
			Grams.	Grams.	Grams.	Calories.	Grams.	Calories.	Grams.	Calories.		
Pecans	....	10 large.	30	.90	3.30	13.5	21.36	198.7	3.99	16.5	229	762
Pistachios	....	10 "	5	.21	1.12	4.6	2.70	25.1	.82	3.4	33	660
Walnuts	....	10 "	42	1.05	7.73	31.7	27.05	251.6	5.46	22.4	306	728
13. NON-ALCOHOLIC BEVERAGES.												
Cocoa	....	1 cup.	227	176.86	9.08	37.2	15.53	144.4	23.85	97.8	279	123
Ingredients: 1 h. tsp. cocoa. 1 " " sugar. ¾ c. milk. 1 tbsp. cream.												
Coffee or tea	....	1 "	246	217.17	2.80	11.5	7.64	71.1	17.83	73.1	156	64
Ingredients: ¼ c. milk. 1 tbsp. cream. 2 cubes sugar. Coffee or tea.												

TABLE 7.—*Prepared Foods—Edible Portion* (*Continued*)

FOOD STUFFS	Portion.	Quantity.	Weight.	Water.	Protein.		Fats.		Carbohydrates.		Total Calories.	Calories per 100 Grams.
			Grams.	Grams.	Grams.	Calories.	Grams.	Calories.	Grams.	Calories.		
Eggnog.	....	1 glass.	270	212.15	13.00	53.3	12.85	119.5	29.50	121.0	294	109
Ingredients:												
1 egg.												
1 h. tbsp. sugar.												
¾ c. milk.												
1 tbsp. sherry.												
Lemonades:												
Egg lemonade	....	1 large glass.	314	259.20	6.70	27.5	5.25	48.8	42.35	173.6	250	80
Ingredients:												
1 egg.												
2 h. tbsp. sugar.												
2 tbsp. lemon juice.												
¾ c. water.												
Lemonade with white of egg	....	" " "	297	250.20	4.10	16.8	.08	.7	42.35	173.6	191	64
Ingredients:												
White 1 egg.												
2 h. tbsp. sugar.												
2 tbsp. lemon juice.												
¾ c. water.												

TABLE 7.—*Prepared Foods—Edible Portion (Continued)*

FOOD STUFFS.	Portion.	Quantity.	Weight.	Water.	Protein.		Fats.		Carbohydrates.		Total Calories.	Calories per 100 Grams.
			Grams.	Grams.	Grams.	Calories.	Grams.	Calories.	Grams.	Calories.		
Lemonades—Continued.												
Plain lemonade	....	1 glass.	264	221.65	.....	.....	.....	.....	42.35	173.6	174	66
Ingredients: 2 h. tbsp. sugar. 2 tbsp. lemon juice. ¾ c. water.												
Malted milk[4]	....	1 cup.	235	191.86	9.71	39.8	10.12	94.1	21.19	86.9	221	94
Ingredients: 1 h.tbsp. malted milk. ⅞ c. milk.												
Mellin's Food[4]	....	1 "	225	191.71	7.66	31.4	8.80	82.0	15.10	62.0	175	78
Ingredients: ½ tbsp. Mellin's Food. ⅞ c. milk.												

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The following tables of alcoholic beverages are taken from Locke, Edwin A. "Food Values," Appleton & Co., N. Y., and are published here through the courtesy of the author.

TABLE 8.—*Alcoholic Beverages**

(*The small numerals in the first column refer to the list of references on page* 735.)

BEVERAGE.	Portion.	Quantity.	Alcohol.	Total Extracts.	Total Fuel Value.	Calories per 100 Grams.
			Per cent. by Weight.	Per cent.	Calories.	
A. DISTILLED LIQUORS.						
Brandy, California	Cordial glass.	20 c.c.	45.80	0.45	65	325
Brandy, cherry	" "	20 "	44.00	.01	62	310
Brandy, cognac, pure French	" "	20 "	55.90	.02	78	390
Cocktail, Dry Martini	Cocktail glass.	75 "	21.30	6.21	131	175
Gin	....	50 "	30.00	5.50	116	232

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* The enormous variation in the composition of alcoholic liquors has made it exceedingly difficult to choose values which should be accurate and comparable. As a rule, the percentages given are averages of a large number of analyses and if not strictly accurate are as nearly so as it is possible to obtain them.

When no authority is given, the figures are averages of those published by one or more authorities and cited by König.

The total extractives are reckoned as sugar, notwithstanding the fact that they comprise other substances than carbohydrates in small amounts which cannot be classed as foods. The percentage of these, however, is so small that the error is negligible.

Alcohol is computed solely on the basis of its function as a food. It must not be overlooked that in more than very moderate quantities it acts as a drug instead, and when taken to excess this action may negative entirely its action as a food, or even interfere with the digestion and absorption of other foods.

TABLE 8.—*Alcoholic Beverages (Continued)*

BEVERAGE.	Portion.	Quantity.	Alcohol.	Total Extracts.	Total Fuel Value.	Calories per 100 Grams.
			Per cent. by Weight.	Per cent.	Calories.	
A. DISTILLED LIQUORS—Continued.						
Liqueurs:						
Benedictine [5]	Cordial glass.	20 c.c.	42.40	35.00	88	440
Chartreuse [5]	" "	20 "	35.20	35.40	78	390
Curacao [5]	" "	20 "	42.00	27.90	82	410
Creme de Menthe	" "	20 "	36.50	28.28	74	370
Kümmel	" "	20 "	26.00	29.80	61	305
Rum	....	50 "	43.50	.13	153	306
Rum, pure Jamaica	....	50 "	69.61	.61	245	490
Whiskey, American, genuine[1]	....	50 "	43.00	.70	152	304
Whiskey, European [1]	....	50 "	39.00	....	137	274
B. WINES AND CIDERS.						
1. *American Wines.*						
California, red [2]	Claret glass.	120 "	9.50	3.10	95	79
California, white [2]	" "	120 "	9.00	2.70	89	74
Sweet wines:						
Catawba [2]	Sherry glass.	30 "	11.07	5.60	30	100
Champagne	Champagne glass.	135 "	8.27	9.74	132	98
Port, California	Sherry glass.	30 "	14.81	12.17	53	176
Sherry, California	" "	30 "	14.67	5.53	38	126

TABLE 8.—*Alcoholic Beverages (Continued)*

BEVERAGE.	Portion.	Quantity.	Alcohol. Percent. by Weight.	Total Extracts. Per cent.	Total Fuel Value. Calories.	Calories per 100 Grams.
B. WINES AND CIDERS—Continued.						
2. *European Wines.*						
Champagne, dry	Champagne glass.	135 c.c.	10.42	2.36	112	83
French, red (claret)	Claret glass.	120 "	8.16	2.42	81	67
French, white	" "	120 "	9.48	3.03	95	79
Mosel and Saar, white	" "	120 "	7.36	2.31	73	61
Rhein, white	" "	120 "	8.12	2.91	83	69
Sweet wines:						
Champagne	Champagne glass.	135 "	9.50	12.88	161	119
Madeira	Sherry glass.	30 "	15.40	5.52	39	130
Malaga	" "	30 "	11.93	21.73	52	173
Marsala	" "	30 "	15.85	5.28	40	133
Port	" "	30 "	16.69	8.05	45	150
Sherry	" "	30 "	17.45	3.98	42	140
Tokay, fresh	" "	30 "	11.19	12.72	39	130
3. *Ciders.*						
American, sweet [3]	Glass.	250 "	1.40	8.20	109	44
American, fermented [3]	"	250 "	5.17	3.88	130	52

TABLE 8.—*Alcoholic Beverages (Continued)*

BEVERAGE.	Portion.	Quantity.	Alcohol.	Total Extracts.	Total Fuel Value.	Calories per 100 Grams.
			Per cent. by Weight.	Per cent.	Calories.	
C. MALT LIQUORS.						
1. *American.*						
Ale	Glass.	250 c.c.	6.02	4.86	155	62
Lager beer, bottled	"	250 "	4.53	4.96	130	52
Lager beer, draft	"	250 "	4.27	4.40	120	48
Porter	"	250 "	4.46	6.00	140	56
2. *European.*						
Ale	"	250 "	5.27	5.99	154	62
Bock beer	"	250 "	4.20	7.10	146	58
Export beer	"	250 "	4.29	6.50	142	57
Light beer	"	250 "	3.69	5.39	120	48
Munich, heavy beer	"	250 "	4.54	9.96	182	73
Pilsen, export beer	"	250 "	4.28	4.69	123	49
Porter (Stout)	"	250 "	5.16	7.97	172	69
Weissbeer	"	250 "	2.79	5.29	103	41

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The following table of "Standard Portions" was prepared by Prof. Irving Fischer* and is published here through his courtesy.

TABLE 9.—*Table of Foods Giving the Weight (in Grams, Ounces and Rough Measure) of a "Standard Portion" of Each Food and the Number of Calories in That "Portion" in the Form of Proteid, Fat and Carbohydrate*

Name of Food	"Portion" Containing 100 Calories Roughly Described	Wt. of 100 Calories		Per Cent of		
		Grams	Ounces	Proteid	Fat	Carbohydrate
Cooked Meats						
*Beef, round, boiled (fat), 1099†	Small serving	36	1.3	40	60	00
*Beef, round, boiled (lean), 1206†	Large serving	62	2.2	90	10	00
*Beef, round, boiled (med.), 1188†	Small serving	44	1.6	60	40	00
*Beef, 5th right rib, roasted, 1538†	Half serving	18.5	.65	12	88	00
*Beef, 5th right rib, roasted, 1616†	Small serving	32	1.2	25	75	00
*Beef, 5th right rib, roasted, 1615†	Very small serving	25	.88	18	82	00
*Beef, ribs boiled, 1169†	Small serving	30	1.1	27	73	00
*Beef, ribs boiled, 1170†	Very small serving	25	.87	21	79	00
‡Calves foot jelly, as purchased	....	112	4.	19	00	81
‡Chicken, as purchased, canned	One thin slice	27	.96	23	77	00
‡Lamb chops, boiled, edible portion, average	One small chop	27	.96	24	76	00
‡Lamb, leg, roast	Ordinary serving	50	1.8	40	60	00
*Mutton, leg, boiled, 1184†	Large serving	34	1.2	35	65	00
*Pork, ham, boiled (fat) 1174†	Small serving	20.5	.73	14	86	00
*Pork, ham, boiled, 1192†	Ordinary serving	32.5	1.1	28	72	00
*Pork, ham, roasted (fat), 1484†	Small serving	27	.96	19	81	00
*Pork, ham, roasted (lean), 1511†	Small serving	34	1.2	33	67	00
‡Turkey, as pur., canned	Small serving	28	.99	23	77	00
*Veal, leg, boiled, 1182†	Large serving	67.5	2.4	73	27	00
Uncooked meats						
‡Beef, loin, edible portion, average (lean)	Ordinary serving	50	1.8	40	60	00
‡Beef, loin, edible portion, average (fat)	Small serving	30	1.1	22	78	00
‡Beef, loin, porterhouse steak, edible por., av	Small steak	36	1.3	32	68	00
‡Beef, loin, sirloin steak, edible portion, av	Small steak	40	1.4	31	69	00
‡Beef, ribs, lean, edible portion, average	Ordinary serving	52	1.8	42	58	00
‡Beef, round, lean, edible portion, average	Ordinary serving	63	2.2	54	46	00
‡Beef, tongue, edible portion, average	Ordinary serving	62	2.2	47	53	00
‡Beef, juice	....	395	14.	78	22	00
‡Chicken (broilers), edible portion, average	Large serving	90	3.2	79	21	00

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* Fischer, Irving, Practical Dietetics, Jour. A. M. A. 48, Apr. 20, 1907.

TABLE 9.—*Table of Foods Giving the Weight (in Grams, Ounces and Rough Measure) of a "Standard Portion" of Each Food and the Number of Calories in That "Portion" in the Form of Proteid, Fat and Carbohydrate* (*Continued*)

Name of Food	"Portion" Containing 100 Calories Roughly Described	Wt. of 100 Calories		Per Cent of		
		Grams	Ounces	Proteid	Fat	Carbohydrate
Uncooked meats (*Continued*)						
‡Clams, round, in shell, edible portion, average	Twelve to sixteen	210	7.4	56	8	36
‡Cod, whole, edible portion	Two servings	138	4.9	95	5	00
‡Goose (young), edible portion, average	Half serving	25	.88	16	84	00
‡Halibut steaks or sec., edible portion, average	Ordinary serving	81	2.8	61	39	00
‡Liver (veal), as purchased, average	Two small servings	79	2.8	61	39	00
‡Lobsters, whole, edible portion, average	Two servings	117	4.1	78	20	2
‡Mackerel (Spanish), whole, edible portion, av	Ordinary serving	57	2.	50	50	00
‡Mutton leg, hind, lean, edible portion, average	Ordinary serving	50	1.8	41	59	00
‡Oysters, in shell, edible portion, average	One dozen	193	6.8	49	22	29
‡Pork, loin chops, edible portion, average	Very small serving	27	.97	18	82	00
‡Pork, ham, smoked, lean, edible portion, av	Small serving	36	1.3	29	71	00
‡Pork, bacon, smoked, med. fat, edible por., av	Small serving	15	.53	6	94	00
‡Salmon (California), ant. sec., ed. por., av	Small serving	42	1.5	30	70	00
Shad, whole, edible portion, average	Ordinary serving	60	2.1	46	54	00
‡Trout, brook, whole, edible portion, average	Two small servings	100	3.6	80	20	00
‡Turkey, edible portion, average	Two small servings	33	1.2	29	71	00
Vegetables						
*Artichokes, as purchased, average, canned	....	430	15	14	0	86
*Asparagus, as purchased, average, canned	....	540	19	33	5	62
*Asparagus, as purchased, average, cooked	....	206	7.19	18	63	19
*Beans, baked, canned	Small side dish	75	2.66	21	18	61
*Beans, Lima, canned	Large side dish	126	4.44	21	4	75

TABLE 9.—*Table of Foods Giving the Weight (in Grams, Ounces and Rough Measure) of a "Standard Portion" of Each Food and the Number of Calories in That "Portion" in the Form of Proteid, Fat and Carbohydrate (Continued)*

Name of Food	"Portion" Containing 100 Calories Roughly Described	Wt. of 100 Calories		Per Cent of		
		Grams	Ounces	Proteid	Fat	Carbohydrate
	Vegetables (*Continued*)					
‡Beans, string, cooked	Five servings	480	16.66	15	48	37
‡Beets, edible portion, cooked	Three servings	245	8.7	2	23	75
‡Cabbage, edible portion		310	11	20	8	72
‡Carrots, edible portion, average, fresh		215	7.6	10	8	82
Carrots, cooked	Two servings	164	5.81	10	34	56
‡Cauliflower, as purchased, average		312	11	23	15	62
‡Celery, edible portion, average		540	19	24	5	71
Corn, sweet, cooked	One side dish	99	3.5	13	10	77
‡Cucumber, sedible portion, average		565	20	18	10	72
‡Egg plant, edible portion, average		350	12	17	10	73
Lentils, cooked		89	3.15	27	1	72
‡Lettuce, edible portion, average		505	18	25	14	61
‡Mushrooms, as purchased, average		215	7.6	31	8	61
‡Onions, fresh, edible portion, average		200	7.1	13	5	82
‡Onions, cooked	Two large servings	240	8.4	12	40	48
‡Parsnips, edible portion, average	1½ serving	152	5.3	10	7	83
Parsnips, cooked		163	5.84	10	34	56
‡Peas, green, canned	Two servings	178	6.3	25	3	72
‡Peas, green, cooked	One serving	85	3	23	27	50
Potatoes, baked	One good sized	86	3.05	11	1	88
‡Potatoes, boiled	One large sized	102	3.62	11	1	88
‡Potatoes, mashed (creamed)	One serving	89	3.14	10	25	65
Potatoes, steamed	One serving	101	3.57	11	1	88
‡Potatoes, chips	One-half serving	17	.6	4	63	33
‡Potatoes, sweet, cooked	Half of av. potato	49	1.7	6	9	85
‡Pumpkins, edible portion, average		380	13	15	4	81
Radishes, as purchased		480	17	18	3	79
Rhubarb, edible portion, average		430	15	10	27	63
‡Spinach, cooked, as purchased	Two ord. servings	174	6.1	15	66	19
‡Squash, edible portion, average		210	7.4	12	10	78
‡Succotash, canned, as purchased, average	Ordinary serving	100	3.5	15	9	76
‡Tomatoes, fresh, as purchased, average	Four av. tomatoes	430	15	15	16	69
Tomatoes, canned		431	15.2	21	7	72
‡Turnips, edible portion, average	Two large servings	246	8.7	13	4	83
Vegetable oysters		273	9.62	10	51	39

TABLE 9.—*Table of Foods Giving the Weight (in Grams, Ounces and Rough Measure) of a "Standard Portion" of Each Food and the Number of Calories in That "Portion" in the Form of Proteid, Fat and Carbohydrate (Continued)*

Name of Food	"Portion" Containing 100 Calories Roughly Described	Wt. of 100 Calories		Per Cent of		
		Grams	Ounces	Proteid	Fat	Carbohydrate
Dairy Products						
‡Butter, as purchased	Ordinary pat or ball	12.5	.44	.5	99.5	00
‡Buttermilk, as purchased	1½ glass	275	9.7	34	12	54
‡Cheese, American, pale, as purchased	1½ cubic in	22	.77	25	73	2
‡Cheese, cottage, as purchased	4 cubic in	89	3.12	76	8	16
‡Cheese, full cream, as purchased	1½ cubic in	23	.82	25	73	2
‡Cheese, Neufchatel, as purchased	1½ cubic in	29.5	1.05	22	76	2
‡Cheese, Swiss, as purchased	1½ cubic in	23	.8	25	74	1
‡Cheese, pineapple, as purchased	1½ cubic in	20	.72	25	73	2
‡Cream	¼ ordinary glass	49	1.7	5	86	9
Kumyss		188	6.7	21	37	42
‡Milk, condensed, sweetened, as purchased		30	1.06	10	23	67
‡Milk, condensed, unsweetened (evap. cream) as purchased		59	2.05	24	50	26
‡Milk, skimmed, as purchased	1½ glass	255	9.4	37	7	56
‡Milk, whole, as purchased	Small glass	140	4.9	19	52	29
‡Whey, as purchased	Two glasses	360	13	15	10	75
Fruits (Dried)						
‡Apples, as purchased, average		34	1.2	3	7	90
Apricots, as purchased, average		35	1.24	7	3	90
‡Dates, edible portion, average	Three large	28	.99	2	7	91
‡Dates, as purchased		31	1.1	2	7	91
‡Figs, edible portion, average	One large	31	1.1	5	0	95
‡Prunes, edible portion, average	Three large	32	1.14	3	0	97
‡Prunes, as purchased		38	1.35	3	0	97
‡Raisins, edible portion, average		28	1.	3	9	88
‡Raisins, as purchased		31	1.1	3	9	88
Fruits (Fresh or Cooked)						
‡Apples, as purchased	Two apples	206	7.3	3	7	90
Apples, baked		94	3.3	2	5	93
Apples, sauce	Ordinary serving	111	3.9	2	5	93
‡Apricots, edible portion, average		168	5.92	8	0	92
Apricots, cooked	Large serving	131	4.61	6	0	94
‡Bananas, yellow, edible portion, portion, average	One large	100	3.5	5	5	90

Table 9.—*Table of Foods Giving the Weight (in Grams, Ounces and Rough Measure) of a "Standard Portion" of Each Food and the Number of Calories in That "Portion" in the Form of Proteid, Fat and Carbohydrate* (*Continued*)

Name of Food	"Portion" Containing 100 Calories Roughly Described	Wt. of 100 Calories		Per Cent of		
		Grams	Ounces	Proteid	Fat	Carbohydrate
Fruits (Fresh or Cooked) (*Continued*)						
‡Blackberries, as purchased, average		170	5.9	9	16	75
Blueberries		128	4.6	3	8	89
‡Blueberries, canned, as purchased		165	5.8	4	9	87
Cantaloupe	Half ord. serving	243	8.6	6	0	94
‡Cherries, edible portion, average		124	4.4	5	10	85
‡Cranberries, as purchased, average		210	7.5	3	12	85
‡Grapes, as purchased, average		136	4.8	5	15	80
Grape fruit		215	7.57	7	4	89
Grape juice	Small glass	120	4.2	0	0	100
Gooseberries		261	9.2	5	0	95
‡Lemons		215	7.57	9	14	77
Lemon juice		246	8.77	0	0	100
Nectarines		147	5.18	4	0	96
Olives, ripe	About seven olives	37	1.31	2	91	7
‡Oranges, as purchased, average	One very large	270	9.4	6	3	91
Oranges, juice	Large glass	188	6.62	0	0	100
‡Peaches, as purchased, average	Three ordinary	290	10.	7	2	91
Peaches, sauce	Ordinary serving	136	4.78	4	2	94
Peaches, juice	Ordinary glass	136	4.80	0	0	100
‡Pears	One large pear	173	5.40	4	7	89
Pears, sauce		113	3.98	3	4	93
‡Pineapples, edible portion average		226	8.	4	6	90
Raspberries, black		146	5.18	10	14	76
Raspberries, red		178	6.29	8	0	92
‡Strawberries, as purchased, average	Two servings	260	9.1	10	15	75
‡Watermelon, as purchased, average		760	27.	6	6	88
Cakes, Pastry, Pudding and Desserts						
‡Cake, chocolate layer, as purchased.	Half ord. square piece.	28	.98	7	22	71
‡Cake, gingerbread, as purchased	Half. ord. square piece.	27	.96	6	23	71
‡Cake, sponge, as purchased	Small piece	25	.89	7	25	68
Custard, caramel		71	2.51	19	10	71
Custard, milk	Ordinary cup	122	4.29	26	56	18
Custard, tapioca	Two-thirds ordinary	69.5	2.45	9	12	79

TABLE 9.—*Table of Foods Giving the Weight (in Grams, Ounces and Rough Measure) of a "Standard Portion" of Each Food and the Number of Calories in That "Portion" in the Form of Proteid, Fat and Carbohydrate (Continued)*

Name of Food	"Portion" Containing 100 Calories Roughly Described	Wt. of 100 Calories		Per Cent of		
		Grams	Ounces	Proteid	Fat	Carbohydrate
Cakes, Pastry, Pudding and Desserts (*Continued*)						
‡Doughnuts, as purchased	Half a doughnut	23	.8	6	45	49
‡Lady fingers, as purchased		27	.95	10	12	78
‡Macaroons, as purchased		23	.82	6	33	61
‡Pie, apple, as purchased	One-third ord. piece	38	1.3	5	32	63
‡Pie, cream, as purchased	One-fourth ord. piece.	30	1.1	5	32	63
‡Pie, custard, as purchased	One-third ord. piece	55	1.9	9	32	59
‡Pie, lemon, as purchased	One-third ord. piece	38	1.35	6	36	58
‡Pie, mince, as purchased	One-fourth ord. piece.	35	1.2	8	38	54
‡Pie, squash, as purchased	One-third ord. piece	55	1.9	10	42	48
Pudding, apple sago		81	3.02	6	3	91
Pudding, brown betty	Half ord. serving	56.6	2.	7	12	81
Pudding, cream rice	Very small serving	75	2.65	8	13	79
Pudding, Indian meal	Half ord. serving	56.6	2	12	25	63
Pudding, apple tapioca	Small serving	79	2.8	1	1	98
Tapioca, cooked	Ordinary serving	108	3.85	1	1	98
Sweets and Pickles						
‡Catsup, tomato as purchased, average		170	6.	10	3	87
‡Honey, as purchased	Four teaspoonfuls	30	1.05	1	0	99
‡Marmalade (orange peel)		28.3	1	.5	2.5	97
‡Molasses, cane		35	1.2	.5	0	99.5
‡Olives, green, edible portion	Seven olives	32	1.1	1	84	15
‡Olives, ripe, edible portion	Seven olives	38	1.3	2	91	7
‡Pickles, mixed, as purchased		415	14.6	18	15	67
‡Sugar, granulated	Three teaspoonfuls or 1½ lumps	24	.86	0	0	100
‡Sugar, maple	Four teaspoonfuls	20	1.03	0	0	100
‡Syrup, maple	Four teaspoonfuls	35	1.2	0	0	100
Nuts						
‡Almonds, edible portion, average	About eight	15	.53	13	77	10
‡Beechnuts		14.8	.52	13	79	8
‡Brazil nuts, edible portion	Three ord. size	14	.49	10	86	4
‡Butternuts		14	.50	16	82	2
‡Cocoanuts		16	.57	4	77	19

Table 9.—*Table of Foods Giving the Weight (in Grams, Ounces and Rough Measure) of a "Standard Portion" of Each Food and the Number of Calories in That "Portion" in the Form of Proteid, Fat and Carbohydrate* (*Continued*)

Name of Food	"Portion" Containing 100 Calories Roughly Described	Wt. of 100 Calories		Per Cent of		
		Grams	Ounces	Proteid	Fat	Carbohydrate
	Nuts (*Continued*)					
‡Chestnuts fresh, edible portion, average	....	40	1.4	10	20	70
‡Filberts, edible portion, average	Ten nuts	14	.48	9	84	7
‡Hickory nuts	....	13	.47	9	85	6
‡Peanuts, edible portion, average	Thirteen double	18	.62	20	63	17
‡Pecans, polished, edible portion	About eight	13	.46	6	87	7
‡Pine nuts (pignolias), edible portion	About eighty	16	.56	22	74	4
‡Walnuts, California, edible portion	About six	14	.48	10	83	7
	Cereals					
‡Bread, brown, as purchased, average	Ordinary thick slice	43	1.5	9	7	84
‡Bread, corn (johnnycake) as purchased, av	Small square	38	1.3	12	16	72
‡Bread, white, home made, as purchased	Ordinary thick slice	38	1.3	13	6	81
Corn flakes, toasted	Ord. cereal dish full	27	.97	11	1	88
‡Corn meal, granular, average	....	27	.96	10	5	85
‡Corn meal, unbolted, edible portion, average	....	26	.92	9	11	80
‡Crackers, graham, as purchased	Two crackers	23	.82	9	20	71
‡Crackers, oatmeal, as purchased	Two crackers	23	.81	11	24	65
‡Hominy, cooked	Large serving	120	4.2	11	2	87
‡Macaroni, average	....	27	.96	15	2	83
‡Macaroni, average, cooked	Ordinary serving	110	3.85	14	15	71
‡Oatmeal, average, boiled	1½ serving	159	5.6	18	7	75
‡Popcorn, average	....	24	.86	11	11	78
‡Rice, uncooked	....	28	.98	9	1	90
‡Rice, boiled, average	Ord. cereal dish	87	3.1	10	1	89
‡Rice, flakes	Ord. cereal dish	27	.94	8	1	91
‡Rolls, Vienna, as purchased, average	One large roll	35	1.2	12	7	81
‡Shredded wheat	One biscuit	27	.94	13	4.5	82.5
‡Spaghetti, average	....	28	.97	12	1	87
‡Wheat flour, entire wheat, average	....	27	.96	15	5	80
‡Wheat flour, graham, average	....	27	.96	15	5	80
‡Wheat flour, patent roller process, family and straight grade spring wheat, average	....	27	.97	12	3	85
‡Zweiback	Size of thick slice of bread	23	.81	9	21	70

TABLE 9.—*Table of Foods Giving the Weight (in Grams, Ounces and Rough Measure) of a "Standard Portion" of Each Food and the Number of Calories in That "Portion" in the Form of Proteid, Fat and Carbohydrate* (*Concluded*)

Name of Food	"Portion" Containing 100 Calories Roughly Described	Wt. of 100 Calories		Per Cent of		
		Grams	Ounces	Proteid	Fat	Carbohydrate
	Miscellaneous					
‡Eggs, hen's, boiled	One large egg	59	2.1	32	68	00
‡Eggs, hen's, whites		181	6.4	100	0	00
‡Eggs, hen's, yolks	Two yolks	27	.94	17	83	00
‡Omelet		94	3.3	34	60	6
‡Soup, beef, as purchased, average		380	13.	69	14	17
‡Soup, bean, as purchased, average	Very large plate	150	5.4	20	20	60
‡Soup, cream of celery, as purchased, average	Two plates	180	6.3	16	47	37
‡Consomme, as purchased		830	29.	85	00	15
‡Clam chowder, as purchased	Two plates	230	8.25	17	18	65

* Experiments on Losses in Cooking Meats (1900–03); Grindley, U. S. Department of Agriculture Bull. No. 141.

† Laboratory number of specimen, as per Experiments on Losses in Cooking Meat.

‡ Chemical Composition of American Food Materials, Atwater and Bryant, U. S. Department of Agriculture, Bull. No. 28.

The following tables of Ash Constituents of Foods are taken from Sherman, H. C. "Chemistry of Food and Nutrition," 3rd Ed. Macmillan, N. Y. and are published by permission of the author.

TABLE 10.—*Ash Constituents of Foods in Percentage of the Edible Portion*

(Compiled from Various Sources)

FOOD	CALCIUM (Ca)	MAGNESIUM (Mg)	POTASSIUM (K)	SODIUM (Na)	PHOSPHORUS (P)	CHLORINE (Cl)	SULPHUR (S)	IRON (Fe)
Almonds	.239	.251	.741	.019	.465	.037	.160	.0039
Apples	.007	.008	.127	.011	.012	.005	.006	.0003
dried	.032	.037	(.623)	(.050)	.048	(.025)	?	(.0015)
Apricots	.014	.010	.248	.038	.025	.002	.010	(.0003)
dried	(.066)	(.047)	(1.157)	(.177)	(.117)	(.009)	?	(.0014)
Asparagus	.025	.011	.196	.007	.039	.039	.041	.0010
Bacon (10% protein)	.006	.012	.169	.042	.108	.038	.115	.0015
Bananas	.009	.028	.401	.034	.031	.125	.010	.0006
Barley, entire	.043	.141	.477	.076	.400	.016	.153	.0041
pearled	.020	(.070)	(.241)	(.037)	.181	(.016)	(.120)	(.0020)
Beans, dried	.160	.156	1.229	.097	.471	.032	.215	.0070
kidney, dry	.132	.139	1.144	.041	.475	.041	.227	.0072
Lima, dry	.071	.188	1.741	.249	.338	.026	.161	.0070
Lima, fresh	.028	(.070)	(.613)	(.088)	.133	(.009)	(.057)	.0020
string, fresh	.046	.025	.247	.019	.052	.024	.030	.0011
Beef lean (20% protein)	.012	.024	.338	.084	.216	.076	.230	.0030
Beets	.029	.021	.353	.093	.039	.058	.016	.0006
Blackberries	.017	.021	.169	(.007)	.034	(.010)	.020	.0006
Blood (avg.)	.008	.004	.075	.261	.031	.280	.137	.0526
Blueberries	.020	.007	.051	.016	.008	.008	.011	.0009
Bluefish (See Fish)								
Bread,								
Boston brown	.129	.078	(.232)	(.394)	.185	(.607)	.201	(.0030)
"entire wheat"	(.05)	(.05)	(.208)	(.394)	(.175)	(.607)	(.120)	(.0016)
graham	(.05)	(.05)	(.291)	(.394)	(.218)	(.607)	.150	(.0025)
rye	.024	.039	.151	.701	.148	1.025	.104	(.0016)
white	.027	.023	.108	(.394)	.093	(.607)	.105	.0009
Breadfruit	.084	.007	.235	.027	.068	.100	.049	
Brussels sprouts	.027	.040	.375	.004	.120	.040	.194	(.0011)
Buckwheat flour	.039	.048	.130	.027	.226	.012	.071	.0012
Butter	.015	.001	.014	(.788)	.017	(1.212)	(.010)	.0002
Buttermilk	.105	.016	.151	.064	.097	.099	.026	.00025

TABLE 10.—*Ash Constituents of Foods in Percentage of the Edible Portion* (*Continued*)

FOOD	CALCIUM (Ca)	MAGNESIUM (Mg)	POTASSIUM (K)	SODIUM (Na)	PHOSPHORUS (P)	CHLORINE (Cl)	SULPHUR (S)	IRON (Fe)
Cabbage	.045	.015	.247	.027	.029	.024	.066	.0011
Cabbage greens	.106	.030	.512	.025	.099	.068	.173	.0018
Cantaloupe	.017	.012	.235	.061	.015	.041	.014	.0003
Capers	.122	.022	.209	.051	.062	—	—	—
Carp (See Fish)								
Carrots	.056	.021	.287	.101	.046	.036	.022	.0006
Cauliflower	.123	.014	.222	.068	.061	.050	.086	.0006
Caviar	.137	.022	.422	.874	.176	1.819	—	—
Celery	.078	.014	.316	.084	.037	.156	.022	.0005
Chard	.150	.071	.318	.086	.040	.039	.124	(.0025)
Cheese	.931	.037	.089	.606	.683	.880	.263	.0013
Cherries	.019	.016	.213	.023	.031	.014	.011	.0004
Cherry juice	.017	.011	.200	.013	.018	.003	.006	(.0003)
Chestnuts	.034	.051	.560	.065	.093	.006	.068	.0007
Chicken (See Meat)								
Chocolate	.092	(.293)	(.563)	.012	.455	(.051)	.085	(.0027)
Cider	.008	.011	.095	.020	.009	.006	.006	(.0002)
Citron	.121	.018	.210	.011	.033	.003	.020	—
Clams, round	.106	.098	.131	.705	.046	1.220	.224	—
soft, long	.124	.079	.212	.500	.122	.910	.213	—
Cocoa	.112	.420	.900	.059	.709	.051	.203	.0027
Coconut, dried	.059	.059	.597	.073	.155	.239	(.056)	—
fresh	.024	.020	.300	.036	.074	.120	.028	—
Coconut milk	.020	.009	.144	—	.010	—	.008	—
Cod (See Fish)								
Corn (maize), mature	.020	.121	.339	.036	.283	.045	.151	.0029
meal	.018	.084	.213	.039	.190	.146	.111	.0009
sweet	.006	.033	.113	.040	.103	.014	.046	.0008
sweet, dried	.021	.121	.414	.146	.376	.050	.167	.0029
Cotton-seed meal	.265	.462	1.390	.234	1.193	.037	.485	—
Cowpeas	.100	.208	1.402	.161	.456	.040	.240	—
Crackers	.022	.011	.100	(.594)	.102	(.910)	.125	.0015
Cranberries	.018	.007	.077	.010	.013	.009	.007	.0006
Cream	.086	.010	.126	.035	.067	.080	.030	.00022
Cucumbers	.016	.009	.140	.010	.033	.030	.020	.0002
Currants, dried	.082	.044	.873	.081	.195	.060	.044	(.0025)
fresh	.026	.017	.211	.007	.038	.006	.014	.0005

TABLE 10.—*Ash Constituents of Foods in Percentage of the Edible Portion* (*Continued*)

FOOD	CALCIUM (Ca)	MAGNESIUM (Mg)	POTASSIUM (K)	SODIUM (Na)	PHOSPHORUS (P)	CHLORINE (Cl)	SULPHUR (S)	IRON (Fe)
Currant juice	.021	.010	.185	(.006)	.018	.004	.005	—
Dandelion	.105	.036	.461	.168	.072	.099	.017	.0027
Dates	.065	.069	.611	.055	.056	.228	.070	.0030
Duck (See Meat)								
Eggplant	.011	.015	(.140)	(.010)	.034	.024	.016	.0005
Eggs	.067	.011	.140	.143	.180	.106	.195	.0030
Egg white	.015	.010	.160	.156	.014	.155	.216	.0001
Egg yolk	.137	.016	.115	.075	.524	.094	.166	.0086
Endive	.104	.013	.380	.109	.038	.167	.035	—
Farina	.021	.025	.120	.065	.125	.076	.155	.0008
Figs, dried	.162	.071	.964	.046	.116	.043	.056	.0030
fresh	.053	.022	.303	.012	.036	.014	.010	—
Fish *								
Flaxseed	.204	.252	.901	.050	.627	.022	.170	—
Flour, buckwheat	.010	.048	.130	.027	.176	.012	.071	.0012
"entire wheat"	.031	(.090)	(.274)	(.037)	.238	(.070)	(.180)	.0025
graham	.039	(.133)	(.457)	(.037)	.364	(.070)	.183	.0037
white	.020	.018	.115	.060	.092	.074	.177	.0010
rye	.018	.081	.463	.019	.289	.055	.123	.0013
Fowl (See Meat)								
Gluten feed	.247	.221	.250	.420	.542	.090	.558	—
Goose (See Meat)								
Gooseberries	.035	.014	.197	.038	.031	—	.011	.0005
Grapefruit	.021	.009	.161	.004	.020	.005	.010	.0003
Grapejuice	.011	.009	.106	.005	.011	.002	.009	.0003
Grapes	.019	.010	.197	.015	.031	.005	.024	.0003
Guava	.014	.008	.384	—	.030	.045	—	—
Haddock (See Fish)								
Halibut (See Fish)								
Ham (See Meat)								
Hazelnuts	.287	.140	.618	.019	.354	.067	.198	.0041
Herring (See Fish)								
Hominy	.011	.058	.174	.020	.144	.046	(.136)	(.0009)

* Average fish is estimated to contain **per 100 grams of protein** as follows: 0.109 gram Ca; 0.133 gram Mg; 1.671 grams K; 0.373 gram Na; 1.148 grams P; 0.528 gram Cl; 1.119 grams S; 0.0055 gram Fe.

TABLE 10.—*Ash Constituents of Foods in Percentage of the Edible Portion* (*Continued*)

FOOD	CALCIUM (Ca)	MAGNESIUM (Mg)	POTASSIUM (K)	SODIUM (Na)	PHOSPHORUS (P)	CHLORINE (Cl)	SULPHUR (S)	IRON (Fe)
Honey	.004	.018	.386	.001	.019	.029	.001	.0007
Horseradish	.096	.039	.468	.062	.076	.016	.190	—
Huckleberries	.020	.007	.051	.016	.008	.008	.011	.0009
Huckleberry wine	.009	.004	.042	.006	.004	.001	.006	—
Jam *								
Jelly	.014	(.010)	(.100)	(.013)	.008	(.004)	(.007)	(.0003)
Kohl-rabi	.077	.030	.370	.050	.071	.053	.057	.0006
Lamb (See Meat)								
Leeks	.058	.014	.199	.081	.006	.024	.072	—
Lemons	.036	.007	.175	.004	.022	.002	.011	.0006
Lemon juice	.024	.010	.127	.009	.010	.003	.006	—
Lemon, sweet	.030	.006	.442	—	.042	.013	.016	—
Lentils, dry	.107	.101	.877	.062	.438	.050	.277	.0086
Lettuce	.043	.017	.339	.027	.042	.074	.014	.0007
Limes	.055	.014	.350	.062	.036	.039	.010	—
Lime juice	—	—	—	—	—	—	.003	—
Linseed meal	.413	.432	1.083	.251	.741	.085	.396	—
Lupins, dry	.191	.191	.840	.073	.520	.034	—	—
Macaroni	.022	.037	.130	.008	.144	.073	.172	.0012
Mackerel (See Fish)								
Mamey	.009	.012	.345	—	.028	.140	—	—
Mango	.021	.007	.235	—	.017	.019	.013	—
Mangolds	.026	.030	.334	.071	.038	.082	.026	—
Maple syrup	.107	.034	.208	.010	.013	(.010)	(.005)	(.003)
Meat †								
Meat extract, solid	.085	.363	7.347	2.394	2.800	3.117	—	—
Meat peptone	.025	.124	2.440	.641	1.130	.561	.222	—
Milk (cow's), whole	.120	.012	.143	.051	.093	.106	.034	.00024
(cow's), skimmed	(.122)	(.012)	(.149)	(.052)	(.096)	(.110)	(.035)	.00025
(cow's), condensed	(.300)	(.032)	(.374)	(.134)	.235	(.280)	(.090)	.0006

* The percentages of the ash constituents in jams are believed to average about two thirds those of the corresponding fruits.

† Average meat is estimated to contain **per 100 grams protein** as follows: 0.058 gram Ca; 0.118 gram Mg; 1.694 grams K; 0.421 gram Na; 1.078 grams P; 0.378 gram Cl; 1.146 grams S; 0.0150 gram Fe.

TABLE 10.—*Ash Constituents of Foods in Percentage of the Edible Portion* (*Continued*)

FOOD	CALCIUM (Ca)	MAGNESIUM (Mg)	POTASSIUM (K)	SODIUM (Na)	PHOSPHORUS (P)	CHLORINE (Cl)	SULPHUR (S)	IRON (Fe)
Milk — *Cont.*								
buffalo	.203	.016	.099	.038	.125	.062	—	—
camel's . . .	.143	.021	.114	.019	.098	.105	—	—
goat's	.128	.013	.145	.079	.103	.014	.037	—
human . . .	.034	.005	.047	.010	.015	.035	—	—
mare's	.083	.007	.081	.010	.054	.029	—	—
sheep's	.207	.008	.187	.030	.123	.071	—	—
Millet	.014	.167	.290	.085	.327	.019	—	—
Molasses	.211	.068	1.349	.019	.044	.317	.129	.0073
Mushrooms . . .	.017	.016	.384	.027	.108	.021	.051	—
Muskmelon . . .	.017	.012	.235	.061	.015	.041	.014	.0003
Mustard	.492	.260	.761	.056	.755	.016	1.230	—
Mutton (See Meat)								
Oatmeal	.069	.110	.344	.062	.392	.069	.202	.0038
Okra	.071	.010	.035	.043	.019	—	—	—
Olives	.122	.002	1.526	.128	.014	.004	.027	.0029
Onions	.034	.016	.178	.016	.045	.021	.070	.0006
Oranges	.045	.012	.177	.012	.021	.006	.011	.0002
Orange juice . .	.029	.011	.182	.008	.016	.003	.009	.0002
Oysters	.052	.037	.091	.459	.155	.590	.187	.0045
Paprika	.229	.164	2.075	.178	.341	.155	—	—
Parsnips	.059	.034	.518	.004	.076	.030	.036	.0006
Peaches	.016	.010	.214	.022	.024	.004	.009	.0003
dried	.034	.056	(.830)	.082	.146	—	.212	(.0012)
Peanuts	.071	.180	.654	.050	.399	.056	.224	.0020
Pears	.015	.011	.132	.016	.026	.011	.010	.0003
Pear juice . . .	.009	.008	.140	—	.011	—	.009	—
Peas, dried . . .	.084	.149	.903	.104	.400	.035	.219	.0057
fresh	.028	.038	.285	.013	.127	.024	.063	.0017
Pecan nuts . . .	.089	.152	(.332)	—	.335	.050	.113	.0026
Pepper, green, fresh	.006	.010	(.139)	—	.026	.013	.014	.0004
Pepper, black, dry	.440	.156	1.140	.131	.188	.312	—	—
Pepper, white, dry	.425	.113	—	—	.233	.029	—	—
Perch (See Fish)								
Persimmons . . .	.022	.009	.292	.011	.021	.002	.005	—
Pineapple . . .	.018	.011	.321	.016	.028	.051	.009	.0005
Plums	.020	.011	.203	.019	.032	.002	.009	.0005

TABLE 10.—*Ash Constituents of Foods in Percentage of the Edible Portion* (*Continued*)

Food	Calcium (Ca)	Magnesium (Mg)	Potassium (K)	Sodium (Na)	Phosphorus (P)	Chlorine (Cl)	Sulphur (S)	Iron (Fe)
Pomegranate	.011	.005	.063	.085	.105	.003	—	.0004
Pork (10% protein)	.006	.012	.169	.042	.108	.038	.115	.0015
Potatoes	.014	.028	.429	.021	.058	.038	.030	.0013
sweet	.019	.028	.397	.039	.045	.094	.024	.0005
Prunes, dried	.054	.055	1.030	.069	.105	.017	.037	.0030
Pumpkin	.023	.008	(.320)	.065	.059	—	.021	(.0008)
Radishes	.021	.012	.218	.069	.029	.054	.041	.0006
Raisins	.064	.083	.820	.133	.132	.082	.051	.0021
Raspberries	.049	.024	.173	—	.052	—	.017	.0006
Raspberry juice	.021	.016	.134	.005	.012	—	.009	—
Rhubarb	.044	.017	.325	.025	.031	.036	.013	.0010
Rice, brown	—	—	—	—	.207	—	—	.0020
white	.009	.033	.070	.025	.096	.054	.117	.0009
Romaine (salad)	.045	.032	.306	.016	.053	.073	.019	—
Rutabagas	.074	.018	.399	.083	.056	.058	.083	—
Rye, entire	.055	.130	.453	.035	.385	.025	.170	.0039
(See also Bread and Flour)								
Salmon (See Fish)								
Sapato	.026	.008	.179	—	.006	.087	—	—
Shredded wheat	.041	.144	—	—	.324	—	—	.0045
Shrimp	.096	—	—	—	—	—	—	—
Soup, canned	.036	—	.033	—	.030	—	—	—
canned vegetable	.025	.013	.101	—	.038	—	.025	—
Spinach	.067	.037	.774	.125	.068	.074	.038	.0036
Squash, summer, seeds removed	.018	.008	.150	.002	—	—	—	(.0006)
with seeds	.024	.012	.180	.004	—	—	—	(.0006)
Squash, winter	.019	.011	.320	.004	—	—	—	(.0006)
Strawberries	.041	.019	.147	.050	.028	.006	.014	.0008
Tamarind	.007	.021	—	—	.072	.007	.009	—
Tapioca	.023	—	—	—	.090	.018	.029	.0016
Tomatoes	.011	.010	.275	.010	.026	.034	.014	.0004
Tomato juice	.006	.010	.310	.015	.015	.055	—	—
Truffles	.024	.018	.404	.077	.062	.039	—	—
Turnips	.064	.017	.338	.056	.046	.041	.065	.0005
Turnip tops	.347	.028	.307	.082	.049	.168	.069	—

TABLE 10.—*Ash Constituents of Foods in Percentage of the Edible Portion* (*Continued*)

FOOD	CALCIUM (Ca)	MAGNESIUM (Mg)	POTASSIUM (K)	SODIUM (Na)	PHOSPHORUS (P)	CHLORINE (Cl)	SULPHUR (S)	IRON (Fe)
Veal (See Meat)								
Vinegar (cider)	.016	.008	.165	—	.013	—	.017	(.0003)
Walnuts	.089	.134	(.332)	—	.358	.040	.172	.0021
Water cress	.187?	.034	.287	.099	.005	.061	.167	.0019
Watermelon	.011	.003	.073	.008	.003	.008	.007	
Wheat, entire (See also Bread and Flour)	.045	.133	.473	.039	.423	.068	.181	.0050
Wheat bran	.120	.511	1.217	.154	1.215	.090	.247	.0078
Wheat germ	.071	.342	.296	.722	1.050	.070	.325	—
Wheat gluten	.078	.045	.007	.028	.200	.050	.920	—
Whey	.044	.008	.157	.038	.035	.119	.009	?
Whortleberries, entire	.031	.021	.261	.021	.042	—	—	—
flesh only	.020	.011	.087	—	.018	—	—	—
Wine (avg.)	.009	.010	.104	.008	.015	.011	.015	(.0003)

The data of the following table were taken from Bulletin 28, U. S. Dept. of Agriculture; Atwater and Bryant.

TABLE 11.—*The Chemical Composition of American Food Materials*

	Water, Per Cent	Protein, Per Cent	Fat, Per Cent	Total Carbohydrates, Per Cent	Ash, Per Cent	Fuel Value per Pound
Beef, Fresh						
Brisket, medium fat	54.6	15.8	28.5	....	.9	1,495
Chuck, including shoulder	65.0	19.2	15.4	....	.9	1,005
Chuck rib	66.8	19.0	13.4	....	1.0	920
Flank	59.3	19.6	21.1	....	.9	1,255
Loin	61.3	19.0	19.1	....	1.0	1,155
Loin, porterhouse steak	60.0	21.9	20.4	....	1.0	1,270
Loin, sirloin steak	61.9	18.9	18.5	....	1.0	1,130
Ribs	57.0	17.8	24.6	....	.9	1,370
Round	67.8	20.9	10.6	....	1.0	745
Beef Organs						
Brain	80.6	8.8	9.3	....	1.1	555
Kidney	76.7	16.6	4.8	.4	1.2	520
Beef liver	71.2	20.4	4.5	1.7	1.6	605
Sweetbreads, as purchased	70.9	16.8	12.1	....	1.6	825
Tongue	70.8	18.9	9.2	....	1.0	740
Beef, Cooked						
Roast, as purchased	48.2	22.3	28.6	....	1.3	1,620
Round steak, fat removed, as purchased	63.0	27.6	7.7	....	1.8	840
Loin steak, tenderloin, broiled	54.8	23.5	20.4	....	1.2	1,300
Sandwich meat, as purchased	58.3	28.0	11.0	....	2.8	985
Beef, Canned						
Corned beef	51.8	26.3	18.7	....	4.0	1,280
Dried beef, as purchased	44.8	39.2	5.4	....	11.2	960
Kidneys, stewed, as purchased	71.9	18.4	5.1	2.1	2.5	600
Roast beef, as purchased	58.9	25.9	14.8	....	1.3	1,105
Tails, ox	47.7	18.5	4.5	....	.8	535
Tongue, whole, as purchased	51.3	19.5	23.2	....	4.0	1,340
Tripe, as purchased	74.6	16.8	8.5	....	.5	670
Veal, Fresh						
Breast	68.2	20.3	11.0	....	1.0	840
Leg	71.7	20.7	6.7	....	1.1	670
Loin	69.5	19.9	10.0	....	1.1	790
Rib	69.8	20.2	9.4	....	1.1	775
Shoulder and flank, medium fat	65.2	19.7	14.4	....	1.1	975
Veal Organs						
Kidneys, as purchased	75.8	16.9	6.4	....	1.3	585
Liver, as purchased	73.0	19.0	5.3	....	1.3	575
Lamb, Fresh						
Breast or chuck	56.2	19.1	23.6	....	1.0	1,350
Leg, hind	58.6	18.6	22.6	....	1.0	1,300
Loin, without kidney and tallow	53.1	18.7	28.3	....	1.0	1,540
Shoulder	51.8	18.1	29.7	....	1.0	1,590
Fore quarter	55.1	18.3	25.8	....	1.0	1,430
Hind quarter	60.9	19.6	19.1	....	1.0	1,170

TABLE 11.—*The Chemical Composition of American Food Materials* (*Continued*)

	Water, Per Cent	Protein, Per Cent	Fat, Per Cent	Total Carbohydrates, Per Cent	Ash, Per Cent	Fuel Value per Pound
Lamb, Cooked						
Chops, broiled	47.6	21.7	29.9	....	1.3	1,665
Leg, roast	67.1	19.7	12.7	....	.8	900
Mutton, Fresh						
Chuck, lean	64.7	17.8	16.3	....	.9	1,020
Shoulder	60.2	17.5	21.8	....	.9	1,245
Fore quarter	52.9	15.6	30.9	....	.9	1,595
Hind quarter	54.8	16.7	28.1	....	.8	1,495
Mutton, Cooked						
Mutton, leg roast	50.9	25.0	22.6	....	1.2	1,420
Muttons, Organs						
Liver, as purchased	61.2	23.1	9.0	5.0	1.7	905
Pork, Fresh						
Ham, fresh	50.1	15.7	33.4	....	.9	1,700
Loin (chops)	50.7	16.4	32.0	....	.9	1,655
Pork Organs, Etc.						
Brains, as purchased	75.8	11.7	10.3	....	1.6	655
Heart, as purchased	75.6	17.1	6.3	....	1.0	585
Kidneys, as purchased	77.8	15.5	4.8	....	1.2	490
Liver, as purchased	71.4	21.3	4.5	1.4	1.4	615
Pork, Pickled, Salted, and Smoked						
Ham, smoked, lean	53.5	19.8	20.8	....	5.5	1,245
Ham, smoked, boiled, as purchased	51.3	20.2	22.4	....	6.1	1,320
Bacon, smoked	20.2	10.5	64.8	....	5.1	2,930
Pork, Canned						
Ham, deviled, as purchased	44.1	19.0	34.1	....	3.3	1,790
Sausage						
Bologna	60.0	18.7	17.6	.3	3.7	1,095
Frankfort, as purchased	57.2	19.6	18.6	1.1	3.4	1,170
Pork, as purchased	39.8	13.0	44.2	1.1	2.2	2,125
Pork, sausage meat, as purchased	46.2	17.4	32.5	....	3.4	1,695
Poultry and Game, Fresh						
Chicken, broilers	74.8	21.5	2.5	....	1.1	505
Goose, young	46.7	16.3	36.2	....	.8	1,830
Turkey	55.5	21.1	22.9	....	1.0	1,360
Chicken liver, as purchased	69.3	22.4	4.2	2.4	1.7	640
Poultry and Game, Cooked						
Capon	59.9	27.0	11.5	....	1.3	985
Turkey, roast	52.0	27.8	18.4	....	1.2	1,295
Fish, Fresh						
Bass, striped, whole	77.7	18.6	2.8	....	1.2	465
Blackfish, whole	79.1	18.7	1.3	....	1.1	405
Bluefish	78.5	19.4	1.2	....	1.3	410
Butter-fish, whole	70.0	18.0	11.0	....	1.2	800
Cod, whole	82.6	16.5	.4	....	1.2	325
Cod, steaks	79.7	18.7	.5	....	1.2	370

TABLE 11.—*The Chemical Composition of American Food Materials* (*Continued*)

	Water, Per Cent	Protein, Per Cent	Fat, Per Cent	Total Carbohydrates, Per Cent	Ash, Per Cent	Fuel Value per Pound
Fish, Fresh.—*Continued.*						
Flounder, whole	84.2	14.2	.6	....	1.3	290
Haddock	81.7	17.2	.3	....	1.2	335
Halibut, steaks or sections	75.4	18.6	5.2	....	1.0	565
Herring, whole	72.5	19.5	7.1	....	1.5	660
Mackerel, whole	73.4	18.7	7.1	....	1.2	645
Mullet, whole	74.9	19.5	4.6	....	1.2	555
Perch, white, whole	75.7	19.3	4.0	....	1.2	530
Perch, yellow, whole	79.3	18.7	.8	....	1.2	380
Pompano, whole	72.8	18.8	7.5	....	1.0	665
Red snapper, whole	78.5	19.7	1.0	....	1.3	410
Salmon, whole	64.6	22.0	12.8	....	1.4	950
Shad, whole	70.6	18.8	9.5	....	1.3	750
Shad, roe, as purchased	71.2	20.9	3.8	2.6	1.5	600
Smelt, whole	79.2	17.6	1.8	....	1.7	405
Spanish mackerel, whole	44.5	14.1	6.2	....	1.0	525
Trout, brook, whole	77.8	19.2	2.1	....	1.2	445
Trout, salmon or lake	70.8	17.8	10.3	....	1.2	765
Weakfish, whole	79.0	17.8	2.4	....	1.2	430
Fish, Cooked						
Bluefish, cooked	68.2	25.9	4.5	....	1.2	670
Spanish mackerel, broiled	68.9	23.7	6.5	....	1.4	715
Fish, Preserved and Canned						
Cod, salt	53.5	25.4	.3	....	*24.7	410
Cod, salt, "boneless"	55.0	27.3	.3	....	†19.0	490
Mackerel, salt, dressed	43.4	17.3	26.4	....	‡21.9	1,435
Salmon, canned	63.5	21.8	12.1	....	2.6	915
Sardines, canned	52.3	23.0	19.7	....	5.6	1,260
Tunney, canned in oil, Russia	51.3	23.8	20.0	0.6	4.3	1,300
Amphibia						
Frogs legs	83.7	15.5	.2	....	1.0	295
Shellfish, Etc., Fresh						
Clams						
long, in shell	85.8	8.6	1.0	2.0	2.6	240
round, in shell	86.2	6.5	.4	4.2	2.7	215
Crabs, hardshell, whole	77.1	16.6	2.0	1.2	3.1	415
Lobster, whole	79.2	16.4	1.8	.4	2.2	390
Oysters in shell	86.9	6.2	1.2	3.7	2.0	235
Scallops, as purchased	80.3	14.8	.1	3.4	1.4	345
Shellfish, Etc., Canned						
Clams, long, as purchased	84.5	9.0	1.3	2.9	2.3	275
Crabs, as purchased	80.0	15.8	1.5	.7	2.0	370
Lobsters, as purchased	77.8	18.1	1.1	.5	2.5	390
Oysters, as purchased	83.4	8.8	2.4	3.9	1.5	335
Shrimp, as purchased	70.8	25.4	1.0	.2	2.6	520

* Two samples averaged 23 per cent common salt.

† One sample contained 19.1 per cent common salt.

‡ Refuse, liquids.

TABLE 11.—*The Chemical Composition of American Food Materials* (*Continued*)

	Water, Per Cent	Protein, Per Cent	Fat, Per Cent	Total Carbohydrates, Per Cent	Ash, Per Cent	Fuel Value per Pound
Eggs						
Hens', uncooked	73.7	13.4	10.5	....	1.0	720
boiled	73.2	13.2	12.0	....	.8	765
boiled whites	86.2	12.3	.2	....	.6	250
boiled yolks	49.5	15.7	33.3	....	1.1	1,705
Dairy Products, Etc.						
Butter, as purchased	11.0	1.0	85.0	....	3.0	3,605
Buttermilk, as purchased	91.0	3.0	.5	4.8	.7	165
Cheese, American, pale, as purchased	31.6	28.8	35.9	*.3	3.4	2,055
Cheese, Cheddar, as purchased	27.4	27.7	36.8	4.1	4.0	2,145
Cheese, Cheshire, as purchased	37.1	26.9	30.7	†.9	4.4	1,810
Cheese, cottage, as purchased	67.0	16.1	.4	3.7	1.6	435
Cheese, Fromage de Brie, as purchased	60.2	15.9	21.0	1.4	1.5	1,210
Cheese, full cream, as purchased	27.0	17.9	24.5	1.2	2.5	1,790
Cheese, Neuchatel, as purchased	42.7	15.1	22.3	.2	2.3	1,275
Cheese, Roquefort, as purchased	39.3	22.6	29.5	1.8	6.8	1,700
Cheese, Swiss, as purchased	28.9	26.1	33.2	.9	4.4	1,920
Koumiss, as purchased	88.8	2.6	1.7	5.1	.4	215
Milk, condensed, sweetened	26.9	8.8	8.3	54.1	1.9	1,520
condensed, unsweetened, "evaporated cream," as purchased	68.2	9.6	9.3	11.2	1.7	780
whole, as purchased	87.0	3.3	4.0	5.0	†.7	325
whey, as purchased	93.0	1.0	.3	5.0	.7	125
Miscellaneous						
Calf's foot jelly, as purchased	77.6	4.3	....	17.4	.7	405
Oleomargarine, as purchased	9.5	1.2	83.0	....	6.3	3,525
Beef juice, as purchased	93.0	4.9	.6	....	1.5	115
Vegetable Food. Flours, Meals, Etc.						
Barley meal and flour	11.9	10.5	2.2	72.8	2.6	1,640
Buckwheat flour	13.6	6.4	1.2	77.9	.9	1,620
Corn flour	12.6	7.1	1.3	78.4	.6	1,645
Corn meal, granular	12.5	9.2	1.9	75.4	1.0	1,655
Corn preparations:						
Hominy	11.8	8.3	.6	79.0	.3	1,650
Hominy, cooked	79.3	2.2	.2	17.8	.5	380
Oatmeal	7.3	16.1	7.2	67.5	1.9	1,860
Oatmeal, boiled	84.5	2.8	.5	11.5	.7	285
Oatmeal, gruel	91.6	1.2	.4	6.3	.5	155
Rolled oats	7.7	16.7	7.3	66.2	2.1	1,850
Rice	12.3	8.0	.3	79.0	.4	1,630
Rye flour	12.9	6.8	.9	78.7	.7	1,630

* Lactic acid.

† According to Farrington and Woll, the ash of cows' milk contains, on the average, K_2O 25.6, Na_2O 12.5, CaO 24.6, P_2O_5 21.2, and Cl 16.3 per cent.

TABLE 11.—*The Chemical Composition of American Food Materials* (*Continued*)

	Water, Per Cent	Protein, Per Cent	Fat, Per Cent	Total Carbohydrates, Per Cent	Ash, Per Cent	Fuel Value per Pound
Vegetable Food.—*Continued.*						
Wheat flour, entire wheat	11.4	13.8	1.9	71.9	1.0	1,675
Gluten	12.0	14.2	1.8	71.1	.9	1,665
Graham	11.3	13.3	2.2	71.4	1.8	1,670
Prepared (self-raising)	10.8	10.2	1.2	73.0	4.8	1,600
Wheat preparations, breakfast foods:						
Cracked and crushed	10.1	11.1	1.7	75.5	1.6	1,685
Farina	10.9	11.0	1.4	76.3	.4	1,685
Glutens	8.9	13.6	1.7	74.6	1.2	1,715
Shredded	8.1	10.5	1.4	77.9	2.1	1,700
Wheat preparations:						
Macaroni	10.3	13.4	.9	74.1	1.3	1,665
Spaghetti	10.6	12.1	.4	76.3	.6	1,660
Vermicelli	11.0	10.9	2.0	72.0	4.1	1,625
Bread, Crackers, Pastry, Etc.						
Bread:						
Brown, as purchased	43.6	5.4	1.8	47.1	2.1	1,050
Corn (johnnycake), as purchased	38.9	7.9	4.7	46.3	2.2	1,205
Rye, as purchased	35.7	9.0	.6	53.2	1.5	1,180
Wheat:						
Buns, as purchased	29.0	6.3	6.5	57.3	.9	1,455
Buns, cinnamon, as purchased	23.6	9.4	7.2	59.1	.7	1,575
Buns, currant, as purchased	27.5	6.7	7.6	57.6	.6	1,515
Graham bread, as purchased	35.7	8.9	1.8	52.1	1.5	1,210
Biscuit, homemade, as purchased	32.9	8.7	2.6	55.3	.5	1,300
Rolls, French, as purchased	32.0	8.5	2.5	55.7	1.3	1,300
Rolls, Vienna, as purchased	31.7	8.5	2.2	56.5	1.1	1,300
White bread, biscuit, as purchased	35.2	8.0	1.4	54.3	1.1	1,220
Zwieback, as purchased	5.8	9.8	9.9	73.5	1.0	1,970
Crackers, Boston (split) crackers, as purchased	7.5	11.0	8.5	1.1	1.9	1,885
Graham crackers, as purchased	5.4	10.0	9.4	73.8	1.4	1,955
Oatmeal crackers, as purchased	6.3	11.8	11.1	69.0	1.8	1,970
Oyster crackers, as purchased	4.8	11.3	10.5	70.5	2.9	1,965
Pretzels, as purchased	9.6	9.7	3.9	72.8	4.0	1,700
Satlines, as purchased	5.6	10.6	12.7	68.5	2.6	2,005
Soda crackers, as purchased	5.9	9.8	9.1	73.1	2.1	1,925
Cake:						
Baker's cake, as purchased	31.4	6.3	4.6	56.9	.8	1,370
Chocolate layer cake, as purchased	20.5	6.2	8.1	64.1	1.1	1,650
Coffee cake, as purchased	21.3	7.1	7.5	63.2	.9	1.625
Cup cake, as purchased	15.6	5.9	9.0	68.5	1.0	1,765
Fruit cake, as purchased	17.3	5.9	10.9	64.1	1.8	1,760
Gingerbread, as purchased	18.8	5.8	9.0	63.5	2.9	1,670
Sponge cake, as purchased	15.3	6.3	10.7	65.9	1.8	1,795

TABLE 11.—*The Chemical Composition of American Food Materials* (*Continued*)

	Water, Per Cent	Protein, Per Cent	Fat, Per Cent	Total Carbohydrates, Per Cent	Ash, Per Cent	Fuel Value per Pound
Bread, Crackers, Pastry, Etc.—*Continued.*						
Cookies, cakes, etc.:						
Molasses cookies, as purchased	6.2	7.2	8.7	75.7	2.2	1,910
Sugar cookies, as purchased	8.3	7.0	10.2	73.2	1.3	1,920
Ginger snaps, as purchased	6.3	6.5	8.6	76.0	2.6	1,895
Lady fingers, as purchased	15.0	8.8	5.0	70.6	.6	1,685
Macaroons, as purchased	12.3	6.5	15.2	65.2	.8	1,975
Wafers, vanilla, as purchased	6.7	6.6	14.0	71.6	1.1	2,045
Doughnuts, as purchased	18.3	6.7	21.0	53.1	.9	2,000
Pie, apple, as purchased	42.5	3.1	9.8	42.8	1.8	1,270
Pie, cream, as purchased	32.0	4.4	11.4	51.2	1.0	1,515
Pie, custard, as purchased	62.4	4.2	6.3	26.1	1.0	830
Pie, lemon, as purchased	47.4	3.6	10.1	37.4	1.5	1,190
Pie, mince, as purchased	41.3	5.8	12.3	38.1	2.5	1,335
Pie, raisin, as purchased	37.0	3.0	11.3	47.2	1.5	1,410
Pudding, rice custard, as purchased	59.4	4.0	4.6	31.4	.6	825
Pudding, tapioca, as purchased	64.5	3.3	3.2	28.2	.8	720
Sugars, Starches, Etc.						
Candy, as purchased	....	....	....	96.0	....	1,785
Honey, as purchased	18.2	.4	....	81.2	2	1,520
Molasses, cane, as purchased	25.1	2.4	....	69.3	3.2	1,290
Starch, cornstarch, as purchased	....	....	....	90.0	....	1,675
Sugar, coffee or brown sugar, as purchased	....	....	....	95.0	....	1,765
Granulated sugar, as purchased	....	....	....	100.0	....	1,860
Maple, as purchased	....	....	....	82.8	....	1,540
Powdered, as purchased	....	....	....	100.0	....	1,860
Vegetables						
Artichokes	79.5	2.6	.2	16.7	1.0	365
Asparagus, cooked, as purchased	91.6	2.1	3.3	2.2	.8	220
Beans, butter, green	58.9	9.4	.6	29.1	2.0	740
Beans, dried	12.6	22.5	1.8	59.6	3.5	1,605
Beans, Lima, dried	10.4	18.1	1.5	65.9	4.1	1,625
Beans, Lima, fresh	68.5	7.1	.7	22.0	1.7	570
Beans, string, cooked	95.3	.8	1.1	1.9	.9	95
Beans, string, fresh	89.2	2.3	.3	7.4	.8	195
Beets, fresh	87.5	1.6	.1	9.7	1.1	215
Cabbage	91.5	1.6	.3	5.6	1.0	145
Carrots, fresh	88.2	1.1	.4	9.3	1.0	210
Cauliflower	92.3	1.8	.5	4.7	.7	140
Celery	94.5	1.1	.1	3.3	1.0	85
Collards	87.1	4.5	.6	6.3	1.5	225
Corn, green	75.4	3.1	1.1	19.7	.7	470
Cucumbers	95.4	.8	.2	3.1	.5	80
Eggplant	92.9	1.2	.3	5.1	.5	130
Greens, turnip-salad, as purchased	86.7	4.2	.6	6.3	2.2	220

TABLE 11.—*The Chemical Composition of American Food Materials* (*Continued*)

	Water, Per Cent	Protein, Per Cent	Fat, Per Cent	Total Carbohydrates, Per Cent	Ash, Per Cent	Fuel Value per Pound
Vegetables.—*Continued.*						
Kohl-rabi	91.1	2.0	.1	5.5	1.3	145
Lettuce	94.7	1.2	.3	2.9	.9	90
Mushrooms	88.1	3.5	.4	6.8	1.2	210
Okra	90.2	1.6	.2	7.4	.6	175
Onions, fresh	87.6	1.6	.3	9.9	.6	225
Parsnips	83.0	1.6	.5	13.5	1.4	300
Peas, dried	9.5	24.6	1.0	62.0	2.9	1,655
Peas, green	74.6	7.0	.5	16.9	1.0	465
Cowpeas, dried	13.0	21.4	1.4	60.8	3.4	1,590
green	65.9	9.4	.6	22.7	1.4	620
Potatoes, raw or fresh	78.3	2.2	.1	18.4	1.0	385
cooked, boiled	75.5	2.5	.1	20.9	1.0	440
cooked, chips	2.2	6.8	39.8	46.7	4.5	2,675
sweet, raw, or fresh	69.0	1.8	.7	27.4	1.1	570
Pumpkins	93.1	1.0	.1	5.2	.6	120
Radishes	91.8	1.3	.1	5.8	1.0	135
Rhubarb	94.4	.6	.7	3.6	.7	105
Ruta-bagas	88.9	1.3	.2	8.5	1.1	190
Sauerkraut	88.8	1.7	0.5	3.8	5.2	125
Spinach, fresh	92.3	2.1	.3	3.2	2.1	110
cooked, as purchased	89.8	2.1	4.1	2.6	1.4	260
Squash	88.3	1.4	.5	9.0	.8	215
Tomatoes, fresh	94.3	.9	.4	3.9	.5	105
Turnips	89.6	1.3	.2	8.1	.8	185
Vegetables, Canned						
Asparagus	94.4	1.5	.1	2.8	1.2	85
Beans, baked	68.9	6.9	2.5	19.6	2.1	600
string	93.7	1.1	.1	3.8	1.3	95
red kidney, as purchased	72.7	7.0	0.2	18.5	1.6	480
Corn, green	76.1	2.8	1.2	19.0	.9	455
Corn and tomatoes, as purchased	87.6	1.6	.4	9.6	.8	225
Okra	94.4	.7	.1	3.6	1.2	85
Okra and tomatoes	91.8	1.1	.3	5.2	1.6	130
Peas, green	85.3	3.6	.2	9.8	1.1	255
Potatoes, sweet	55.2	1.9	.4	41.4	1.1	820
Pumpkins	91.6	.8	.2	6.7	.7	150
Squash	87.6	.9	.5	10.5	.5	235
Succotash	75.9	3.6	1.0	18.6	.9	455
Tomatoes	94.0	1.2	.2	4.0	.6	105
Pickles, Condiments, Etc.						
Catsup, tomato	82.8	1.5	.2	12.3	3.2	265
Olives, green	58.0	1.1	27.6	11.6	1.7	1,400
ripe	64.7	1.7	25.9	4.3	3.4	1,205
Peppers (paprika), green, dried as purchased	5.0	15.5	8.5	63.0	8.0	1,820

TABLE 11.—*The Chemical Composition of American Food Materials* (*Continued*)

	Water, Per Cent	Protein, Per Cent	Fat, Per Cent	Total Carbohydrates, Per Cent	Ash, Per Cent	Fuel Value per Pound
Pickles, Condiments, Etc.—*Continued.*						
Pickles, cucumber	92.9	.5	.3	2.7	3.6	70
mixed, as purchased	93.8	1.1	.4	4.0	.7	110
spiced, as purchased	77.1	.4	.1	20.7	1.7	395
Fruits, Berries, Etc., Fresh						
Apples	84.6	.4	.5	14.2	.3	290
Apricots	85.0	1.1	....	13.4	.5	270
Bananas, yellow	75.3	1.3	.6	22.0	.8	460
Blackberries	86.3	1.3	1.0	10.9	.5	270
Cherries	80.9	1.0	.8	16.7	.6	365
Cranberries	88.9	.4	.6	9.9	.2	215
Currants, as purchased	85.0	1.5	....	12.8	.7	265
Figs, fresh, as purchased	79.1	1.5	....	18.8	.6	380
Grapes	77.4	1.3	1.6	19.2	.5	450
Huckleberries	81.9	.6	.6	16.6	.3	345
Lemons	89.3	1.0	.7	8.5	.5	205
Muskmelons	89.5	.6	....	9.3	.6	185
Oranges	86.9	.8	.2	11.6	.5	240
Peaches	89.4	.7	.1	9.4	.4	190
Pears	84.4	.6	.5	14.1	.4	295
Pineapple	89.3	.4	.3	9.7	.3	200
Plums	78.4	1.0	....	20.1	.5	395
Prunes	79.6	.9	....	18.9	.6	370
Raspberries red as purchased	85.8	1.0	....	12.6	.6	255
Raspberries, black	84.1	1.7	1.0	12.6	.6	310
Strawberries	90.4	1.0	.6	7.4	.6	180
Watermelons	92.4	.4	.2	6.7	.3	140
Fruits, Etc., Dried						
Apples	28.1	1.6	2.2	66.1	2.0	1,350
Apricots	29.4	4.7	1.0	62.5	2.4	1,290
Citron	19.0	.5	1.5	78.1	.9	1,525
Currants, Zante	17.2	2.4	1.7	74.2	4.5	1,495
Dates	15.4	2.1	2.8	78.4	1.3	1,615
Figs	18.8	4.3	.3	74.2	2.4	1,475
Grapes, ground, as purchased	34.8	2.8	.6	60.5	1.2	1,205
Pears, as purchased	16.5	2.8	5.4	72.9	2.4	1,635
Prunes	22.3	2.1	....	73.3	2.3	1,400
Raisins	14.6	2.6	3.3	76.1	3.4	1,605
Fruits, Etc., Canned, and Jellies, Preserves, Etc.						
Apple sauce, as purchased	61.1	.2	.8	37.2	.7	730
Apricots, as purchased	81.4	.9	....	17.3	.4	340
Blackberries, as purchased	40.0	.8	2.1	56.4	.7	1,150
Cherries, as purchased	77.2	1.1	.1	21.1	.5	415
Figs, stewed, as purchased	56.5	1.2	.3	40.9	1.1	785
Marmalade (orange peel), as purchased	14.5	.6	.1	84.5	.3	1,585

TABLE 11.—*The Chemical Composition of American Food Materials* (*Continued*)

	Water, Per Cent	Protein, Per Cent	Fat, Per Cent	Total Carbohydrates, Per Cent	Ash, Per Cent	Fuel Value per Pound
Fruits, Etc., Canned; and Jellies, Preserves, Etc.—*Continued.*						
Peaches	88.1	.7	.1	10.8	.3	220
Pears	81.1	.3	.3	18.0	.3	355
Pineapples, as purchased	61.8	.4	.7	36.4	.7	715
Strawberries, stewed, as purchased	74.8	.7	....	24.0	.5	460
Tomato preserves, as purchased	40.9	.7	.1	57.6	.7	1,090
Nuts						
Almonds	4.8	21.0	54.9	17.3	2.0	3,030
Brazil nuts	5.3	17.0	66.8	7.0	3.9	3,265
Butternuts	4.4	27.9	61.2	3.5	2.9	3,165
Cocoanuts	14.1	5.7	50.6	27.9	1.7	2,760
prepared	3.5	6.3	57.4	31.5	1.3	3,125
Filberts	3.7	15.6	65.3	13.0	2.4	3,290
Peanuts	9.2	25.8	38.6	24.4	2.0	2,560
Pecans, polished	3.0	11.0	71.2	13.3	1.5	3,455
Walnuts, California	2.5	18.4	64.4	13.0	1.7	3,300
Miscellaneous						
Chocolate	5.9	12.9	48.7	30.3	2.2	2,860
Cocoa	4.6	21.6	28.9	37.7	7.2	2,320
Unclassified Food Materials						
Animal and Vegetable						
Soups, homemade						
Beef soup	92.9	4.4	.4	1.1	1.2	120
Bean soup, as purchased	84.3	3.2	1.4	9.4	1.7	295
Chicken soup, as purchased	84.3	10.5	.8	2.4	2.0	275
Clam chowder	88.7	1.8	.8	6.7	2.0	195
Soups, canned						
Asparagus, cream of, as purchased	87.4	2.5	3.2	5.5	1.4	285
Bouillon	96.6	2.2	.1	.2	.9	50
Celery, cream of, as purchased	88.6	2.1	2.8	5.0	1.5	250
Chicken gumbo	89.2	3.8	.9	4.7	1.4	195
Chicken soup	93.8	3.6	.1	1.5	1.0	100
Consomme, as purchased	96.0	2.5	....	.4	1.1	55
Cream, corn of, as purchased	86.8	2.5	1.9	7.8	1.0	270
Julienne, as purchased	95.9	2.7	....	.5	.9	60
Mock turtle	89.8	5.2	.9	2.8	1.3	185
Mulligatawny	89.3	3.7	.1	5.7	1.2	180
Oxtail	88.8	4.0	1.3	4.3	1.6	210
Pea soup	86.9	3.6	.7	7.6	1.2	235
Tomato soup	90.0	1.8	1.1	5.6	1.5	185
Vegetable, as purchased	95.7	2.9	....	.5	.9	65
Miscellaneous						
"Infants' and invalids' foods"	6.0	12.7	3.3	76.2	1.8	1,795
Mincemeat, commercial	27.7	6.7	1.4	60.2	4.0	1,305
homemade	54.4	4.8	6.7	32.1	2.0	970
Salad, ham, as purchased	69.4	15.4	7.6	5.6	2.0	710

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